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FEDERAL
AN ESTERLINE COMPANY

Manual Part No.
MS 80AD00

SURF-INDICATOR®

AD SERIES
SYSTEM

Consisting of:

21-1350-00	Surf-Indicator®
21-1440-01	Portable Motor Drive
21-1171-00	Probe
21-1360-01	Digital Readout
21-1370-10,-16	Digital Printout

Now manufactured, sold and serviced by:
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439138	A-20 System	21-1350-00	7.18
239137	Power Board	21-1350-00	7.19
339134	Amplifier Board	21-1350-00	7.20
287301	Digital Readout Board	21-1360-01	7.25

SECTION I

GENERAL INFORMATION

1.1 SCOPE

This manual describes the AD Series Surface Measurement System. Contained in this manual are the description of components, installation, operation, maintenance (including calibration and adjustments), and an illustrated parts breakdown.

1.2 DESCRIPTION

a. General

The AD Series Surface Measurement System (Figure 1-1) consists of the following standard components:

Model 21-1440-01 Portable Motor Drive

Model 13-1350-00 Surf Indicator

Model 21-1171-00 Probe (Standard)

Accessory components may be added to the AD Series System. They are as follows:

Model 21-1360-01 Digital Readout

Model 21-1370-10,-16 Digital Printout (Printer)

The components are lightweight, portable, and designed for a production floor environment. Its flexibility permits selection of a wide range of sensitivity and cutoff scales.

The AD Series System meets or exceeds ANSI B46.1-1962, MIL-I-45177, and MIL-STD-10 specifications for stylus type instruments. A reference speciment is provided to calibrate the system.

b. Portable Motor Drive

The Model 21-1440-01 Portable Motor Drive is housed in a steel carrying case. Smoothness of stroke makes it ideal for accurate measurement of intricate or difficult to get areas, as well as for quantity inspection of identical parts. The stroke arm is actuated by an AC motor designed to permit immediate reversal of the stroke arm. The stroke is continuously adjustable over its entire length from less than 1/16-inch (0.16 cm) to 2-1/2 inches (6.4 cm) by means of an adjustable stop on the stroke arm.

c. Surf Indicator

The Model 13-1350-00 Surfindicator is capable of being operated from either an AC line or battery. The meter is large and easy to read. It can be used in either English or Metric units for Ra or RMS applications. Meter scales range from 0 - 3 microinches to 0 - 3000 microinches. It has four roughness width cutoffs from 0.003 to 0.100 inch.

d. Digital Readout

The Model 21-1360-01 Digital Readout permits direct reading of roughness values. It must be used in conjunction with the Surface Indicator on AC power only.

e. Digital Printout (Printer)

The Model 21-1370-10,-16 Printer provides a permanent printed record on 1-3/4 inch wide thermal paper. Readouts can be either English or Metric. The Printer slaves off of the binary coded decimal output of the Digital Readout. It must be used in conjunction with the Surface Indicator and Digital Readout.

f. Probe (Standard)

The Model 21-1171-00 Probe (standard) is equipped with a diamond stylus having a spherical tip radius of 0.0005 inch (0.013 mm).

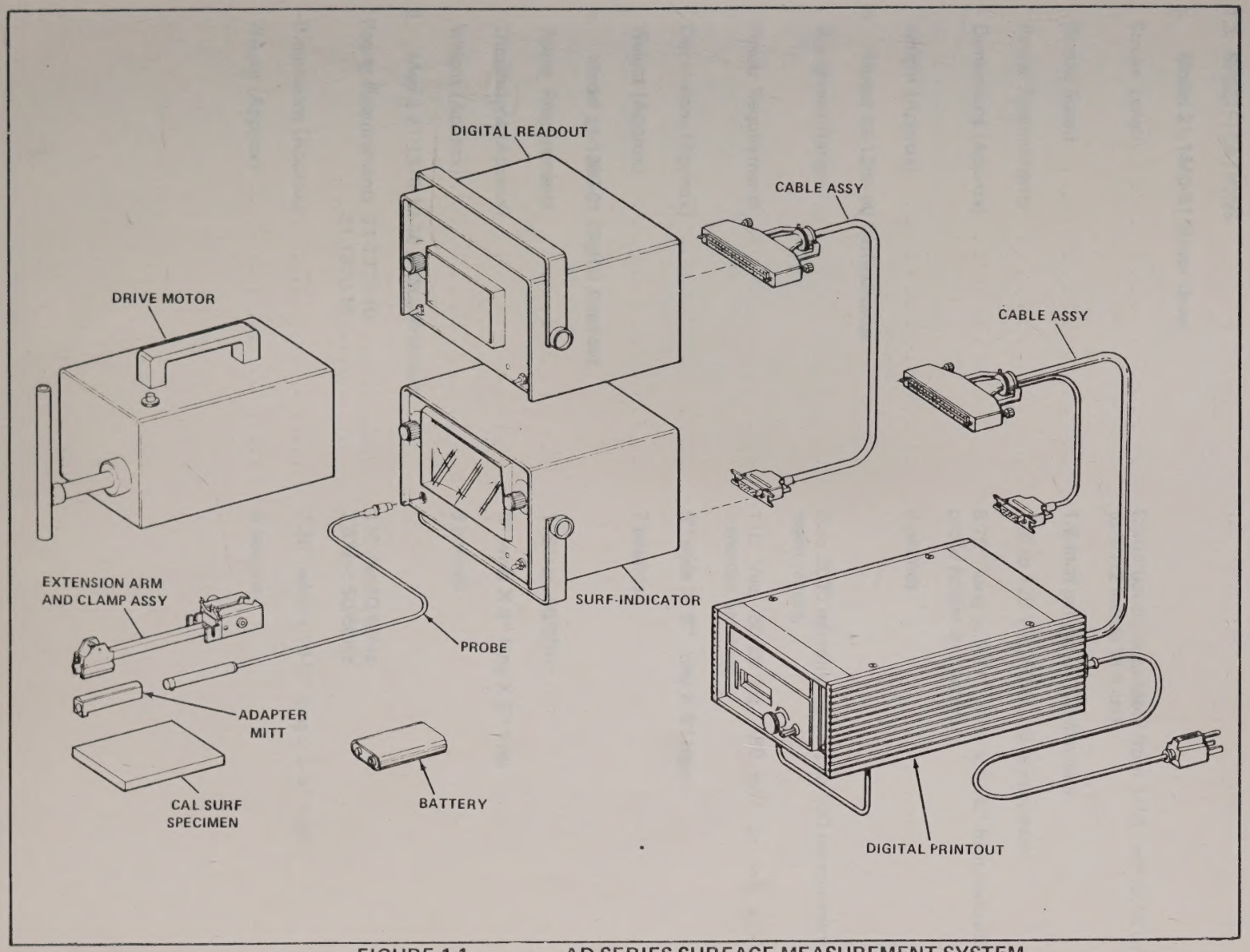


FIGURE 1-1 AD SERIES SURFACE MEASUREMENT SYSTEM

1.3 SPECIFICATIONS

a. Model 21-1440-01 Motor Drive

Stroke Length	Continuously adjustable from 1/16 inch (0.16 cm) to 2-1/2 inches (6.4 cm)
Stroke Speed	1/8-inch per sec (3.175 mm/sec)
Power Requirements	105 to 125 Vac, 60Hz, 10 W maximum
Dimensions (Approx)	8.75" long x 5.61" wide x 5.75" high, excluding probe holder and handle
Weight (Approx)	8 pounds

b. Model 13-1350-00 Surfindicator

Roughness Range	0 to 3000 microinches or 0 to 100 micrometers in seven ranges.
Power Requirements	115 Vac, 50/60 Hz, 150 mW; or two 9 Vdc transistor batteries.
Dimensions (Approx)	9" wide X 8" long X 5" high
Weight (Approx)	7 pounds

c. Model 21-1360-01 Digital Readout

Power Requirements	115 Vac, 50/60Hz
Dimensions (Approx)	9" wide X 8" long X 5" high
Weight (Approx)	6 pounds

d. Model 21-1370-10-16 Digital Printout

Power Requirements 21-1370-10	115Vac 50/60Hz
21-1370-16	230Vac 50/60Hz
Dimensions (Approx)	7-38" wide x 10-½" long x 3-½" high
Weight (Approx)	8 pounds

1.4 SUPPLIES AND ACCESSORIES

SURFACE INDICATOR MODEL 21-1350-00

Part Number	Description
21-9010-01	Calibrated Reference Specimen
21-1200-00	Adapter Mitt
21-1171-00	Standard Probe
21-1172-00(Optional)	Chisel Stylus Probe
21-1173-00(Optional)	Minimum Clearance Probe
21-1174-00(Optional)	Small Bore Probe
21-1175-00(Optional)	Hole Bottom Probe
21-1176-00(Optional)	High Roughness Probe
21-0415-00(Optional)	High Roughness Adapter Mitt
234738(Optional)	Guide for 21-1172-00 with 31-119918-4004 screw)
247280(Optional)	Power Cord

The above probes are furnished with their appropriate mitts.

290073	Battery 9V
236620-8(Optional)	Probe Extension 8 in.
236620-10(Optional)	Probe Extension 10 in.
236620-12(Optional)	Probe Extension 12 in.
236620-14(Optional)	Probe Extension 14 in.

PRINTER MODEL 21-1370-10, -16

Part Number	Description
291732	Paper, Thermal

SECTION II

INSTALLATION

2.1 GENERAL

The AD Series Surface Measurement System requires no special installation procedures. This section contains inspection checks, general equipment setup, and Digital Readout and Printer connections.

2.2 INCOMING INSPECTION

Visually inspect units and accessories for damage that may have occured during shipment. Refer to warranty card in case of damage. Cross check packing list and equipment. Report any deficiencies to the factory immediately.

2.3 GENERAL EQUIPMENT SETUP

It is very important that the work to be measured and the Motor Drive be placed on the same solid surface. A heavy metal surface or granite plate is best. This will minimize vibration. The work surface should also be well anchored. Make measurements away from heavy machinery if possible. Plasticene or modeling clay may be used to hold the work steady. Large or heavy pieces usually will require no support. On large quantity runs, it may be desirable to design special jigs to increase speed and uniformity of readings.

2.4 DIGITAL READOUT INSTALLATION

The Digital Readout must be used in conjunction with the Surface Indicator. Place Digital Readout along side or on top of the Surface Indicator. Plug its cable into the rear of the Surface Indicator after the Surface Indicator has been calibrated. Place Surface Indicator SENSITIVITY switch in 300 position if calibrated in microinches - 3 position if calibrated in micrometers. Place DIGITAL-METER switch in DIGITAL position.

2.5 PRINTER INSTALLATION

The Printer must be used in conjunction with both the Surfindicator and Digital Readout. Printer readout will be either in microinches or micrometres depending upon position of Surface Indicator SENSITIVITY switch (300 = microinches -3 = micrometers). Install Printer as follows:

1. Remove all external power from System.
2. Plug the 15-pin connector into the rear of the Surface Indicator and attach with clips provided.
3. Plug 22-pin connector into rear of Digital Display and attach with screws provided.
4. Connect power cords from the Motor Drive, Surface Indicator, and Printer to 110Vac, 60Hz line, or 230 Vac, 50Hz line.
5. Calibrate System per Section V.
6. Turn POWER to Printer ON. LED light above toggle switch should illuminate.

The Printer will now print out the values displayed by the Digital Readout when the toggle switch is pressed down to print.

SECTION III

OPERATION

3.1 GENERAL

This section describes and illustrates controls and operation of the AD Series Surface Measurement System. The Motor Drive and Surface Indicator may be used together by themselves or with the accessory Digital Readout and Printer. The Printer must be used in conjunction with the Digital Readout and the Digital Readout must be used in conjunction with the Surface Indicator.

3.2 CONTROLS AND INDICATORS

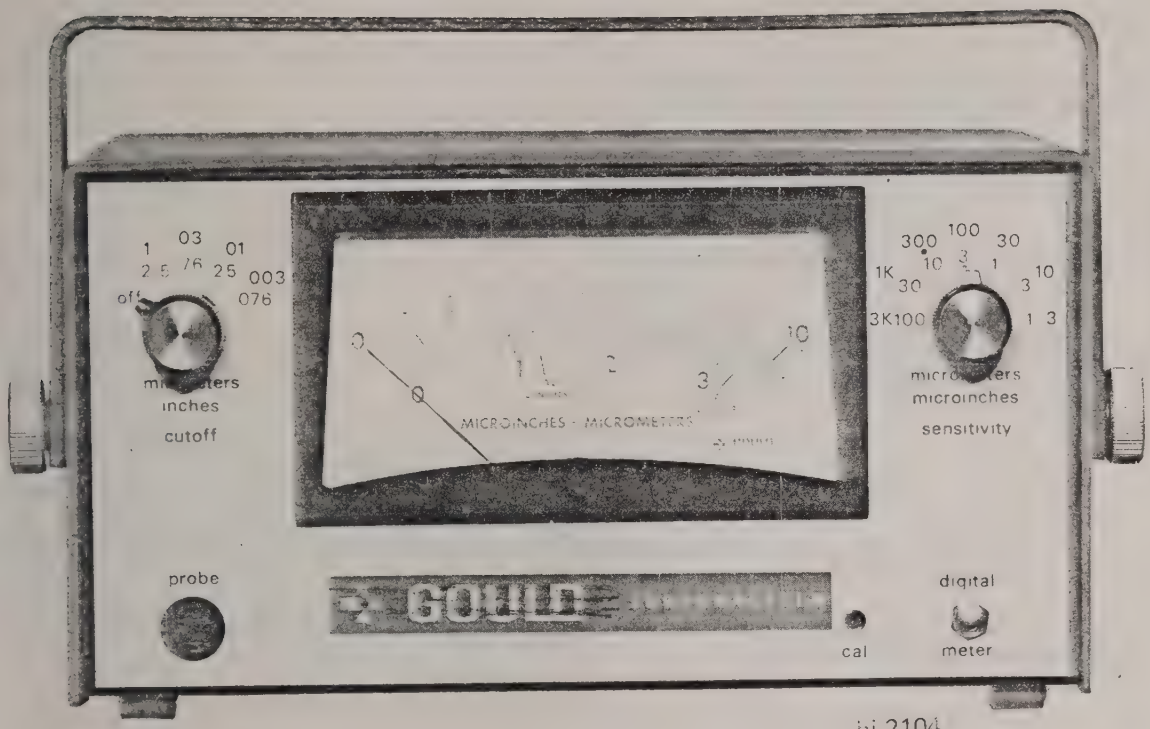
a. Motor Drive

A variety of applications may be arranged from the various rods, couplings, and extension arms supplied. They are as follows:

1. Vertical extension rod (5" long - 12.7 cm)
2. Horizontal extension rod (4" long -10.2 cm)
3. Two couplings provided with 3/4-inch (1.9 cm) knurled knobs for quick and rigid tightening.

b. Surfindicator (Figure 3-1)

CUTOFF	Selects roughness width cutoff to be employed during a measurement. Cutoff's available are 0.003 inch (0.0762 mm), 0.010 inch (0.254 mm), 0.030 inch (0.762 mm), and 0.10 inch (2.54 mm). Also serves as ON/OFF switch for AC and battery power.
METER	Has two scales –zero thru 10, and zero thru 3. Four calibration marks are provided. Their use is explained in the Calibration Section.
SENSITIVITY	Permits selection of full scale roughness readings: 3, 10, 30, 100, 300, 1000, 3000 microinches, and 0.1, 0.3, 1.0, 3.0, 10, 30, 100 millimeters.
PROBE	Input receptacle for probe.
CAL	Screwdriver adjustment for system calibration.
DIGITAL-METER	Switch to select either METER or optional digital display and printer.
LINE	Power cord receptacle for 110 Vac, 50-60 Hz operation (230 Vac, 50-60Hz optional).
DIGITAL READOUT	Connector for connection of digital readout display unit.
BATTERY-AC	Switch for selection of either 115 Vac, 50-60Hz or internal battery operation (two standard 9Vdc transistor type batteries.



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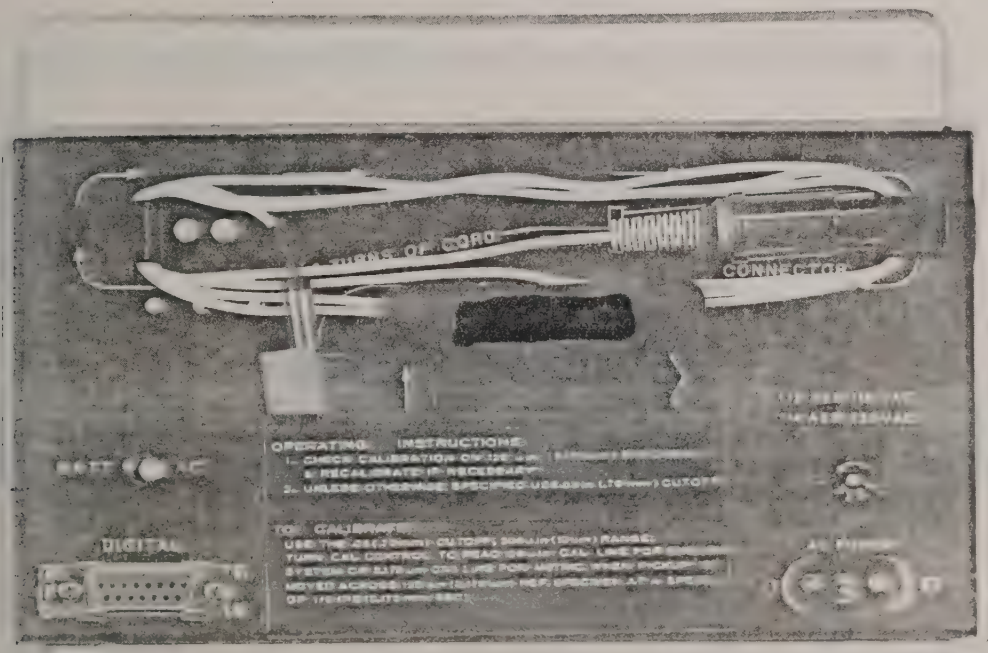

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FIGURE 3-1 SURFINDICATOR CONTROLS

c. Digital Readout (Figure 3-2)

TIME DELAY	Adjustment for fast mode to allow stablization of meter. Full clockwise increased time delay. Full counterclockwise position is OFF.
MICROMETERS/MICROINCHES	Selects readout in either micrometers or microinches.
CAL	Screwdriver adjustment for calibration of digital display.
RESET/RUN	Reset cancels slow mode of reader to permit reading of new test piece. Run allows reading when time delay is adjusted to slow mode.

d. Printer (Figure 3-3)

ON/OFF	On and off toggle switch.
PAPER INDICATOR	Mechanical pointer which rides on paper roll, indicating relative amount of paper left.
PRINT/REMOTE/ADVANCE ..... Print:	When switch is pushed down, printer prints one line and stops. After print and advance, external input is accepted even if the switch is held down.
Remote:	Center position enables all external inputs.
Advance:	When switch is held up, the printer continuously advances paper without printing.

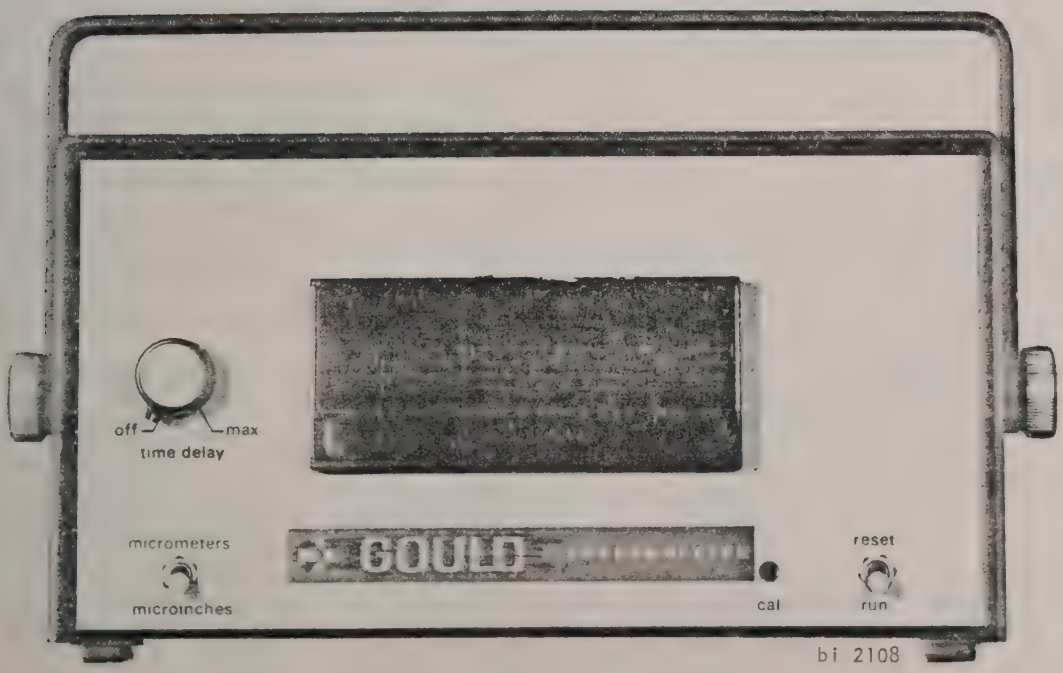


FIGURE 3-2 DIGITAL READOUT CONTROLS

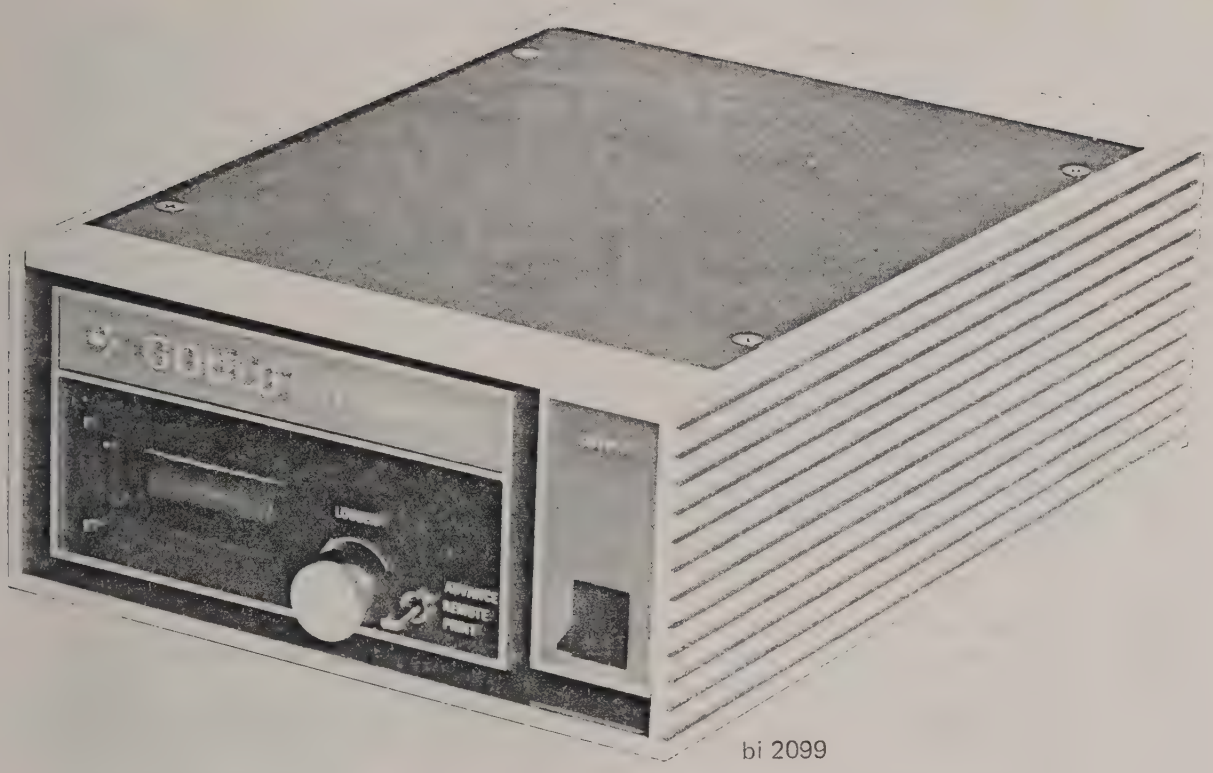


FIGURE 3-3 DIGITAL PRINTOUT CONTROLS

3.3 MOTOR DRIVE OPERATION

Securely fasten the vertical extension to the stroke arm. The bottom of this post is threaded and the top has a screwdriver slot. Press POWER switch to start motor. Let motor run until stroke arm and vertical extension rod have moved to a position farthest from the case. Turn OFF motor. Refer to Figure 3-4 for a typical set up.

3.4 SURFINDICATOR OPERATION

a. Cutoff Wavelengths

On most surfaces, waviness will occur along with roughness. Waviness is the more gradual up-and-down variation of the surface that may be caused by slight variations in machine work. Roughness is the fine local texture of the material. It is caused by the properties of the material, sharpness of the machine cutting tool, size of abrasive particles used in polishing, etc.

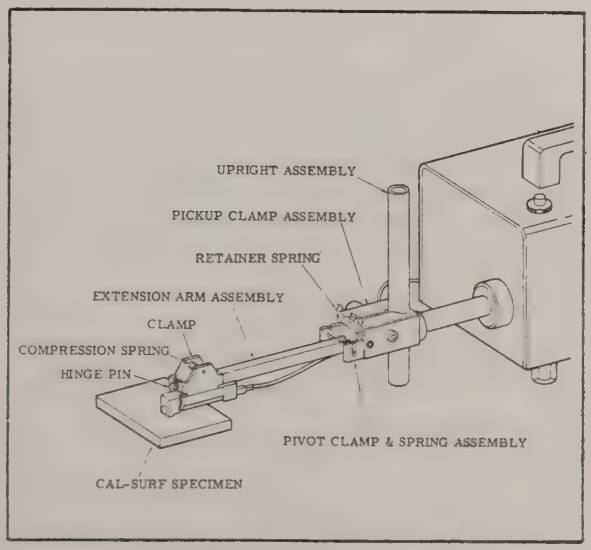


FIGURE 3-4 TYPICAL SETUP FOR CALIBRATION USING CAL SURF SPECIMEN

It is necessary that the Surfindicator be able to distinguish between roughness and the longer wavelengths of waviness. This indicator is equipped with wavelength cutoff feature. Selection of the proper wavelength cutoff is done by a front panel switch.

NOTE: These cutoff wavelengths apply only at a scanning speed on 1/8-inch (3.175 mm) per second.

b. Averaging Methods

Surface roughness is defined as the average deviation of the surface from a mean line. This average deviation is commonly computed by either of two methods. The Ra method computes the arithmetical-average deviation. The RMS method computes the deviation, using the mathematical root-mean-square. The Indicator will compute roughness by either method.

c. Probe Operation Using Cal Surf Specimen

The Surfindicator may now be set up on the same work surface as the Motor Drive (Figure 3-5).

Set the Surfindicator controls as follows:

Battery-AC switch to AC position.

Meter-Digital switch to meter position.

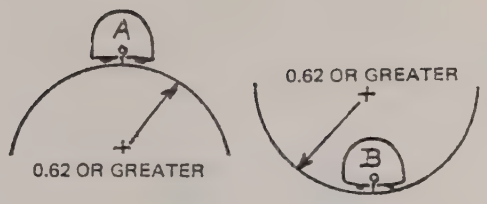
Cutoff switch to OFF position.

Sensitivity switch to 300 microinches position.

Unwind the probe connector from the rear panel and remove the probe with its skid mitt from pocket.

Position the probe in its mitt so that the diamond stylus is directly between and on the center line of the two jewel skids of the mitt (Figure 3-6).

NOTE: One end of adapter is marked "A" for use on outside dimensions when the surface OD is 0.62 of an inch or greater. The other end of the adapter is marked "B" for measuring hole surfaces when the ID is 0.62 of an inch or greater.



Plug the probe into the receptacle provided on the front of the Surfindicator.

Remove the certified reference specimen and place the specimen on the work surface.

Place the probe in the probe clamp of the Motor Drive such a way that the diamond stylus is away from the drive and place the probe on the surface of the specimen. Orient the specimen so that the stroke will be at a right angle to the lay of the specimen.

Recheck the probe mounting to insure that contact with the surface under test is maintained for the diamond stylus and adapter mitt skids throughout the stroke length.

3.5 DIGITAL READOUT OPERATION

Set up the Surfindicator for AC operation as described previously. Digital Readout will not function with Surfindicator in battery mode.

Place the digital Readout alongside or on top of the Surfindicator and plug its cable into the rear of the Surfindicator after calibration. Leave the sensitivity switch at the 300 position if calibrated for microinches; leave the sensitivity switch at 3 position if calibrated for micrometers. Transfer the digital meter switch to the digital position.

NOTE: The Surfindicator sensitivity switch positions are emphasized for digital readout by dots placed under the 300 position for microinch and 3 position for micrometer readouts.

Turn the time delay control to OFF position, full CCW.

Place run-reset switch to RUN position.

Place microinch-micrometer switch to position for which the indicator was calibrated.

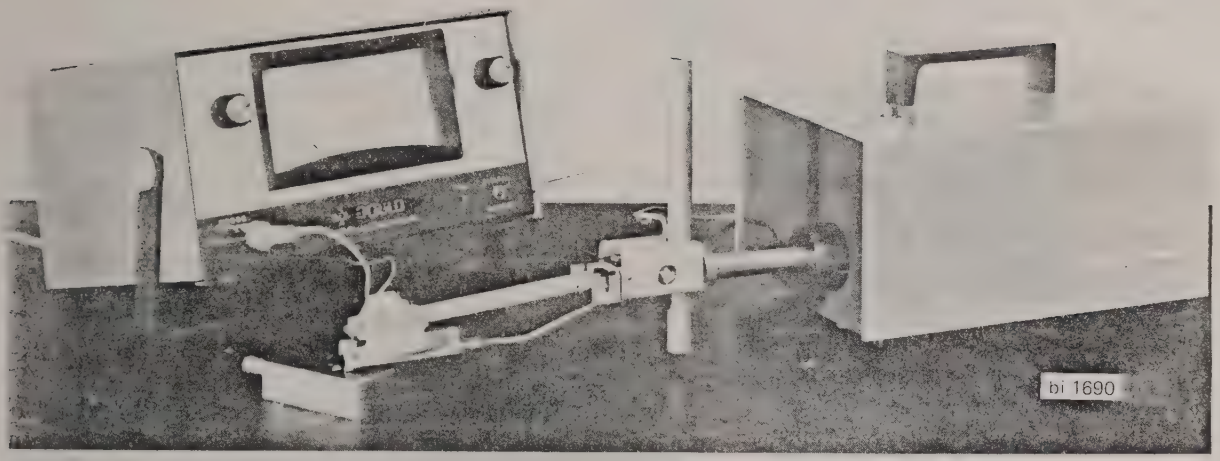


FIGURE 3-5 TYPICAL SETUP (SURFINDICATOR AND MOTOR DRIVE)

FIGURE 3-6 STANDARD PROBE MODEL 21-1171-00 CORRECTLY INSTALLED IN THE ADAPTER MITT

Turn on Motor Drive and adjust the CAL control on digital readout with a screwdriver until the same reading is obtained as during meter calibration.

Time delay may now be set to meet operator's preference. The surface finish may be read directly from the digital readout: the scaling will be automatic, from 1 microinch to 1999 microinches when sensitivity switch is left at the 300 microinch position; or when calibrated for micrometer readout, from 0.01 micrometers to 19.99 micrometers when sensitivity is left at the 3 micrometer position. The RUN-RESET switch must be cycled through the reset position and back to run when a new reading is desired if the time delay feature is being used.

SECTION IV

MAINTENANCE

4.1 GENERAL

The AD Series Measurement System requires no special maintenance procedures. Defective units should be returned to the factory or an authorized representative for repair. The System, including probes, is covered by a one-year warranty. Read warranty card carefully, fill it out, and return to the factory.

4.2 ROUTINE MAINTENANCE

The components of the AD Series Measurement System are precision instruments. Observe care when handling and using. Operate only in a clean atmosphere. Never dip robes into oil, solvent, or any cleaning solution. If the probe becomes jammed by a small piece of dirt or other foreign matter, remove material carefully with a tweezers.

Keep components clean and free from oil and grime. Operation will be adversly affected by dust or oil in probes and Motor Drive mechanism.

Batteries should be replaced after every 150 hours of intermittent operation or when weak.

4.3 BATTERY REPLACEMENT (Figure 4-1)

Turn Surfindicator CUTOFF switch to OFF position. Disconnect AC line cord, probe and Digital Readout. Swing carrying handle up, allowing the Surface Indicator to rest on its feet. Remove the two knurled knobs and remove carrying handle and top half of case. Replace batteries. Reassemble and check calibration.

For electronic parts replacements, refer to the appropriate parts list and its associated schematic diagram at the end of this manual.

4.4 PAPER REPLACEMENT (Figure 4-2)

1. Shut off all power to the printer.
2. Slide out printer subassembly by first loosening the front panel thumbscrew counterclockwise until it stops. Pull the thumbscrew straight out until subassembly is released from housing.
3. Raise the paper loading door by pulling forward until it stops. (see Figure 4-2).
4. Grasp both ends of the paper supply core and pull straight up. The core will slide past the circular retaining spring as shown in Figure 4-2.
5. Insert core in new roll of paper. Slide new roll past the retaining spring and thread paper following the path in diagram 4-2.
6. When paper is in viewing area, close the paper loading door and slide printer subassembly into housing. Press front panel assembly firmly into the housing as far as it will go.
7. Rotate the thumbscrew clockwise until it stops and turn power on. Paper may be manually advanced by pulling out of the front slot.

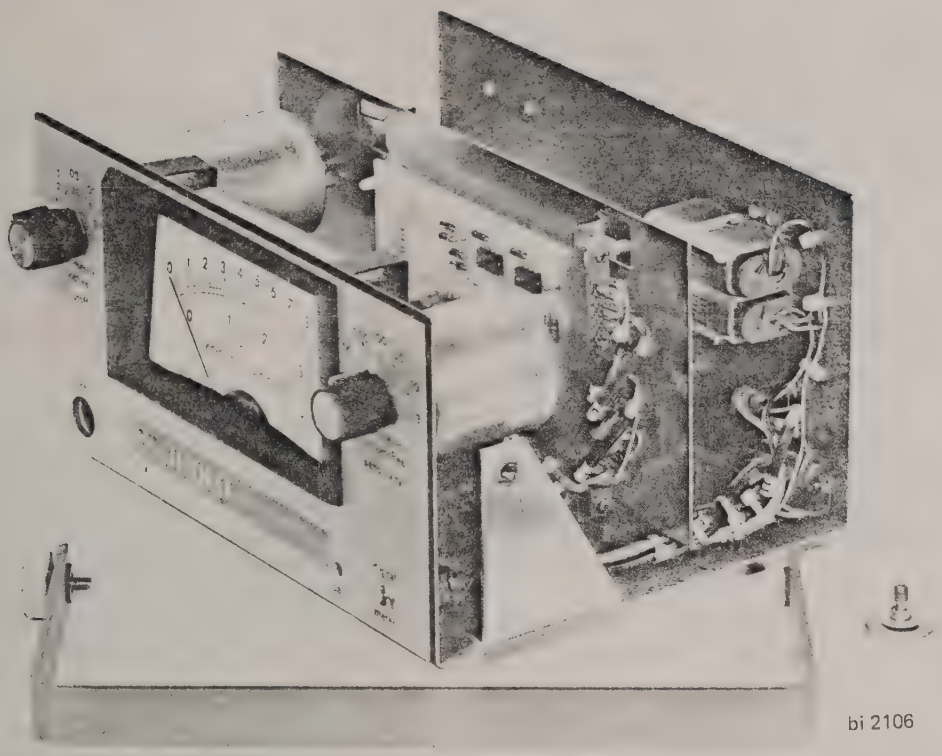


FIGURE 4-1 SURFINDICATOR BATTERY REPLACEMENT

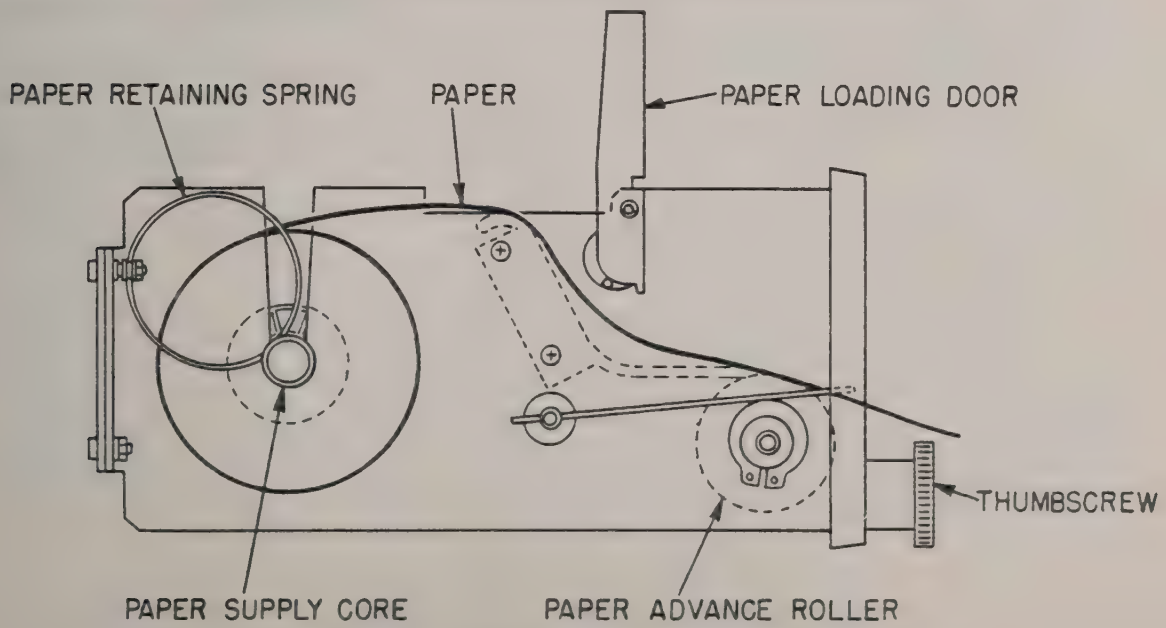


FIGURE 4-2 PRINTER PAPER REPLACEMENT

SECTION V

SURFINDICATOR CALIBRATION

5.1 GENERAL

Brief calibration instructions are located on the rear of the Indicator. This calibration procedure is to be done using the 125 Ra Cal Surf Specimen, and at a stylus speed of 1/8-inch (3.175 mm) per second.

5.2 CALIBRATION IN MICROINCHES

a. Set SENSITIVITY switch to 300 microinch position.

b. Turn ON Surfindicator, rotating CUTOFF switch to 0.03 inch position.

c. Turn ON Motor Drive. Stroke length should be no less than five times the roughness width cutoff selected. A typical stroke length of 0.5 inch should be used. Care should be taken that the stylus does not drop off the edge of the specimen. Damage to the stylus could result.

d. Adjust CAL screwdriver control until meter indicates at the CAL uINCHES mark on the meter for arithmetic average or the DOT slightly upscale for RMS values.

5.3 CALIBRATION IN MICROMETERS

a. Set SENSITIVIY switch to 3 micrometer position.

b. Turn ON Surfindicator, rotating CUTOFF switch to 0.76 position.

c. Turn ON Motor Drive. Stroke length should be no less than five times the roughness width cutoff selected. A typical stroke length of 12.7 millimeters should be used. Care should be taken that the stylus does not drop off the edge of the specimen. Damage to the stylus could result.

d. Adjust CAL screwdriver control until meter indicates at the CAL meters mark on the meter for arithmetic average or the DOT slightly upscale for RMS values.

5.4 CALIBRATION NOTES

a. After calibration in either microinches or micrometers, the cutoff may be changed to meet particular requirements or specifications.

b. Calibration should always be checked when changing probes or the mechanical linkage of the Motor Drive.

c. When calibrating using the internal batteries, and the Surface Indicator will not calibrate, batteries are weak and should be replaced.

d. When calibration is complete, set SENSITIVITY switch according to the roughness specification of the work piece to be checked and note the reading on the meter scale.

SECTION VI

PROBE OPTIONS

6.1 GENERAL

This section describes the various probe options available.

a. Chisel Stylus (Figure 6-1)

Chisel Stylus, Model 21-1172-00 shown measuring the outside diameter of a small cylinder. It may also be used to measure a knife edge.

b. Minimum Clearance Probe (Figure 6-2)

Minimum Clearance Probe, Model 21-1173-00 shown using a gage block as a reference surface. The probe is capable of measuring a hole with a minimum inside diameter of 5/64 inches (1.98mm) to a depth of 0.400 inches (10/16mm).

c. Small Bore Probe (Figure 6-3)

Small Bore Probe, Model 21-1174-00 shown measuring the inside of a tube. The probe is capable of measuring a hole with a minimum inside diameter of 1/8 inch (3.175mm) to a depth of 0.85 inch (21.59mm).

d. Hole Bottom Probe (Figure 6-4)

Hole Bottom Probe, Model 21-1175-00 shown measuring the bottom of a groove. Measurements may be made to a maximum depth of 0.250 inches (6.35mm).

e. High Roughness Probe (Figure 6-5)

High Roughness Probe, Model 21-1176-00 shown with its special High Roughness Adapter Mitt, Model 22-0415-00 measuring a casting. It is recommended that this combination be employed whenever the surface finish requirements exceed 300 microinches.

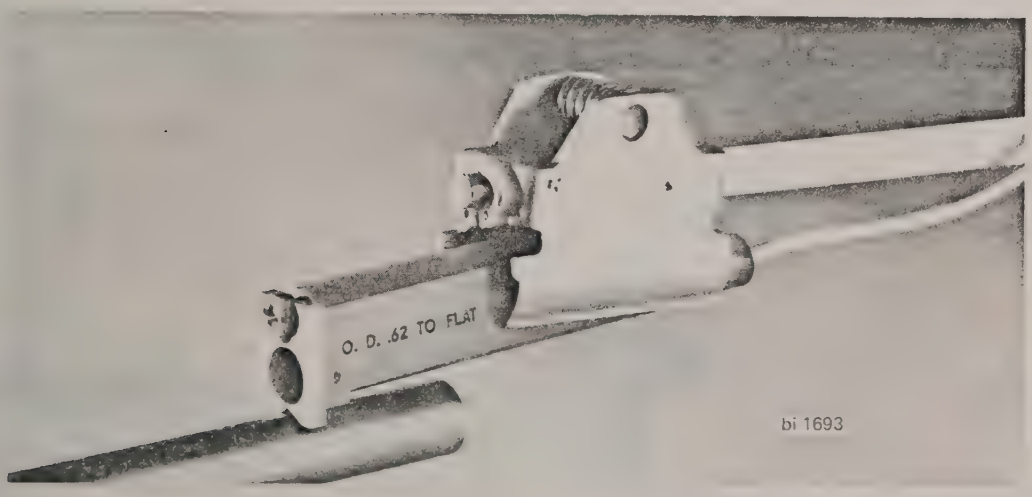


FIGURE 6-1 CHISEL STYLUS-MODEL 21-1172-00

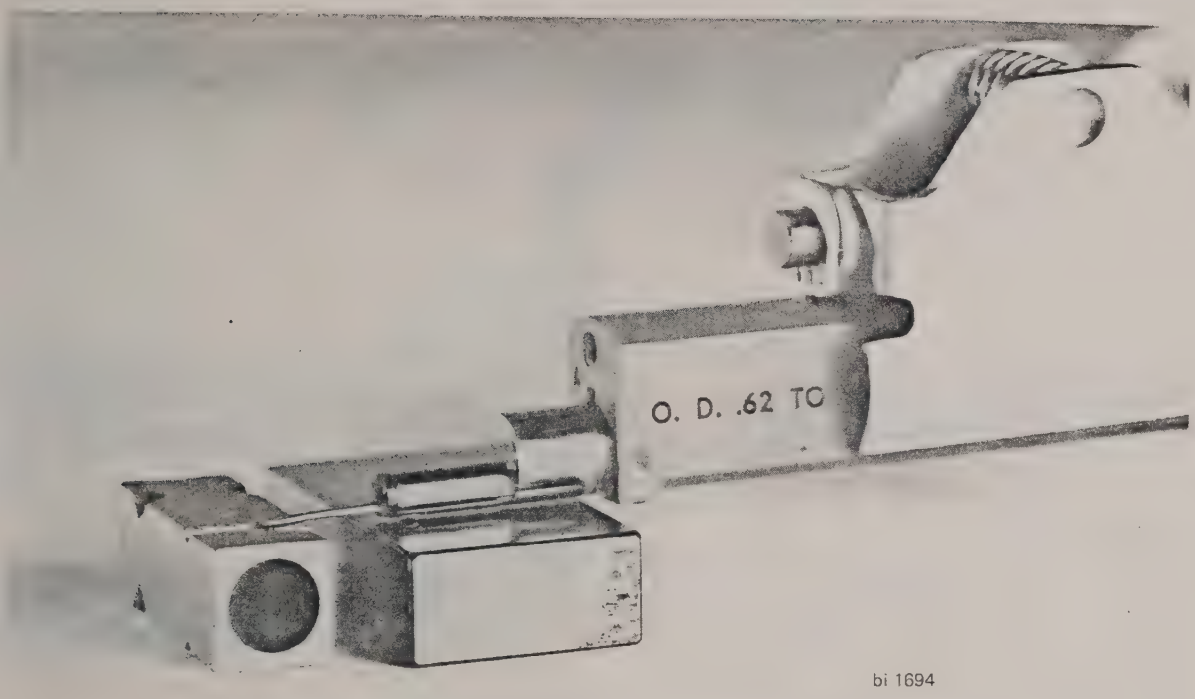


FIGURE 6-2 MINIMUM CLEARANCE PROBE - MODEL 21-1173-00

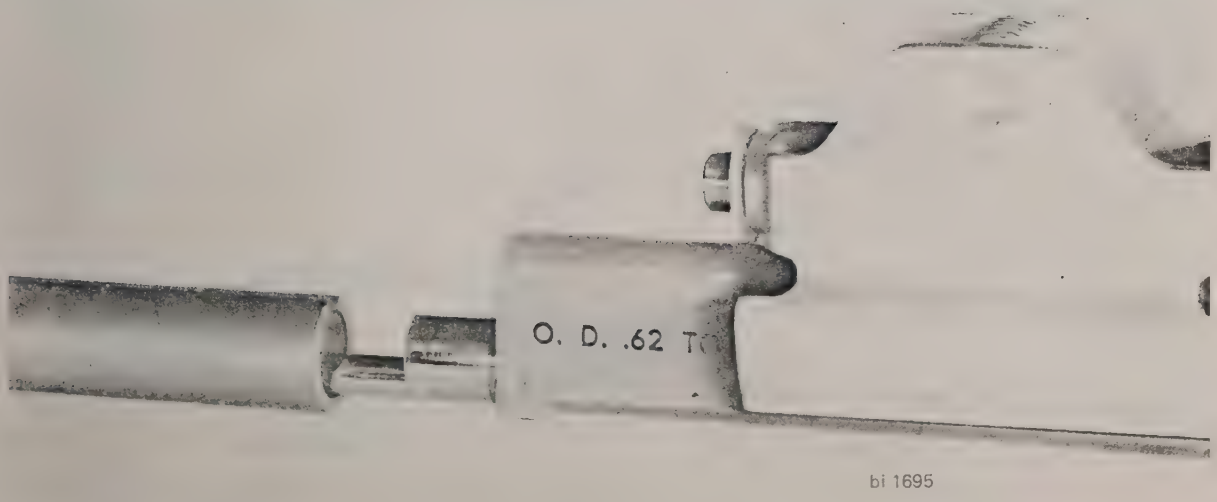


FIGURE 6-3 SMALL BORE PROBE - MODEL 21-1174-00

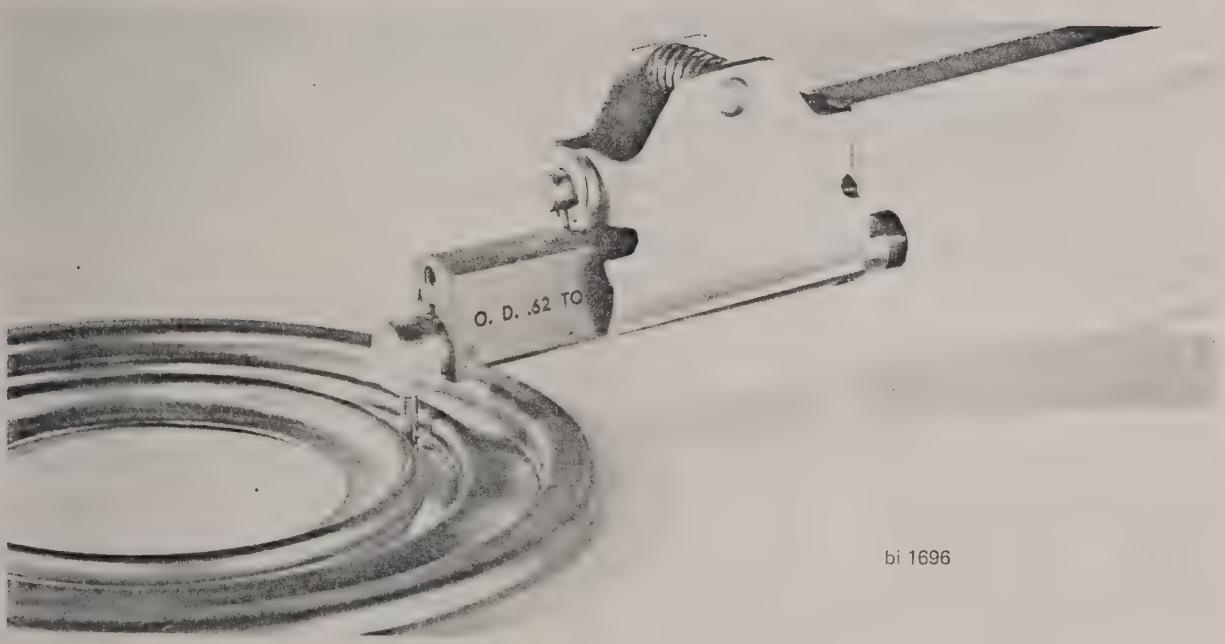


FIGURE 6-4 HOLE BOTTOM PROBE - MODEL 21-1175-00

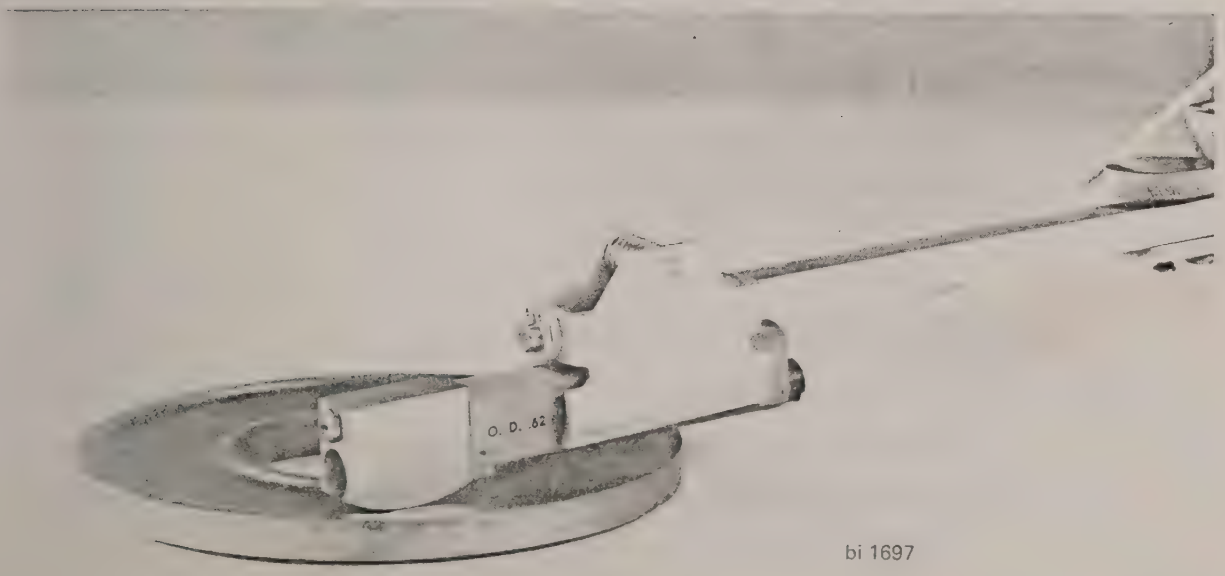


FIGURE 6-5 HIGH ROUGHNESS PROBE - MODEL 21-1176-00

SECTION VII

PARTS IDENTIFICATION

7.1 GENERAL

This AD Series Surf-Analyzer System has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Federal Branch Office or Federal sales representative.

For replacement parts, refer to Figures 7-1 thru 7-8 and their respective parts lists. The items listed represent the lowest provisioned assembly or part available. When ordering parts, include model number, part number, and description of part. Do not use the symbol number from the parts list for identifying desired parts on the order.

NOTE: Replacement of drive unit components in the field is not recommended because performance specifications of the then repaired unit cannot be guaranteed.

AD SERIES SURFACE MEASURING SYSTEM
FIGURE 7-1

ITEM NO	PART NUMBER	DESCRIPTION
1	21-1440-01	Drive Unit Assembly (see Figure 7-2)
2	21-1171-00	Probe, Standard
	21-1172-00	Probe, Chisel Stylus (Optional)
	21-1173-00	Probe, Minimum Clearance (Optional)
	21-1174-00	Probe, Small Bore (Optional)
	21-1175-00	Probe, Hole Bottom(Optional)
	21-1176-00	Probe, High Roughness (Optional)
3	21-1200-01	Mitt, Adapter
	22-0415-00	Mitt, Adapter, High roughness (Optional)
4	750254	Arm and Clamp Assy (See Figure 7-3)
5	787297	Cable Assy (Optional) -01 only
	738901	Cable Assy (Optional) -00 only
6	891474	Cable Assy (Optional)
7	21-1350-00	Surfindicator (see Figure 7-4)
8	21-1360-01	Digital Readout (Optional) (see Figure 7-7)
9	21-1370-10,-16	Digital Printout (Optional)
10	21-9010-01	Specimen, Cal-Surf
11	290073	Battery 9V

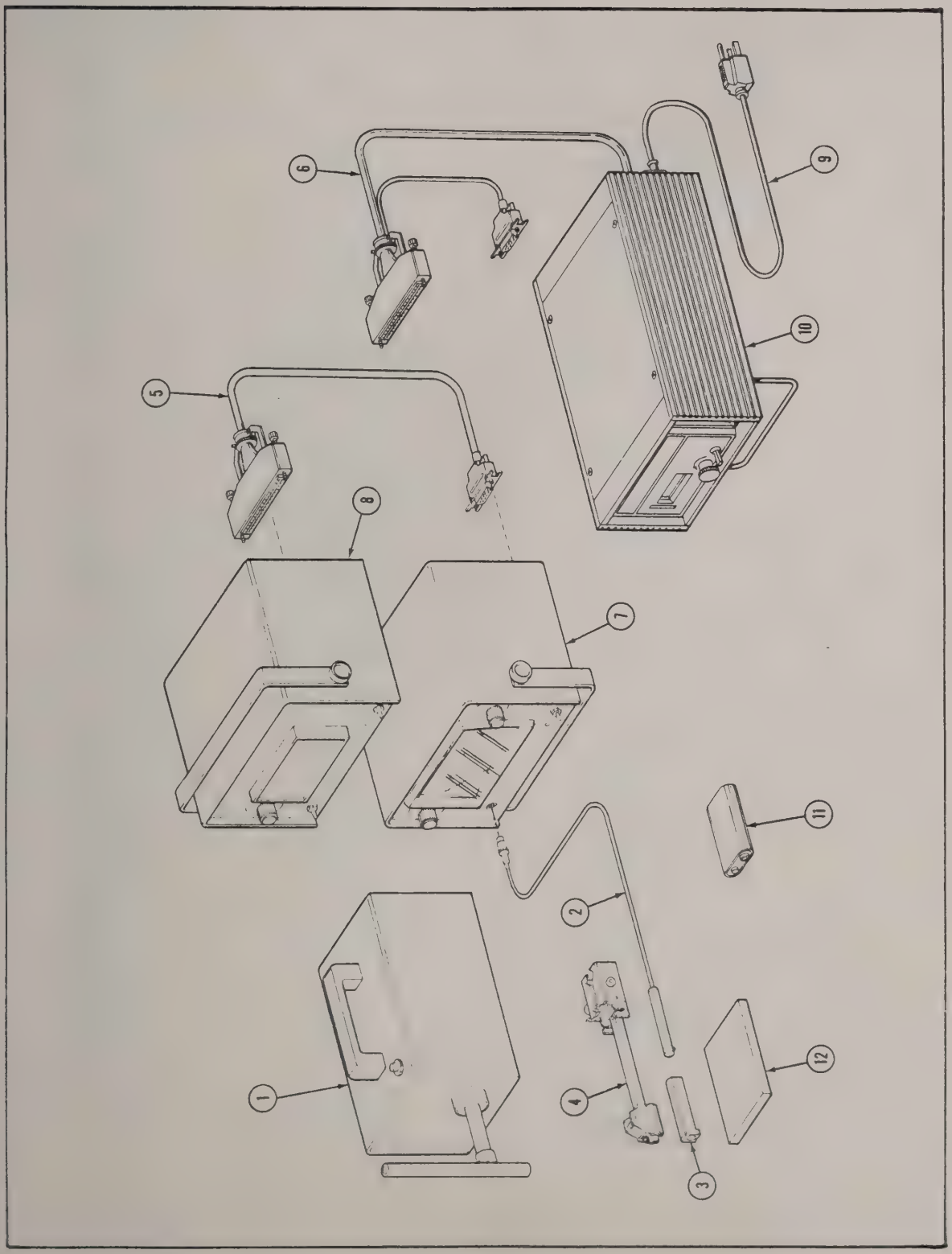


FIGURE 7-1 AD SERIES SURFACE MEASUREMENT SYSTEM

DRIVE UNIT ASSEMBLY (850160)
MODEL 21-1440-01
FIGURE 7-2

ITEM NO	PART NUMBER	DESCRIPTION
	21-1440-01	Drive Motor Assy
1	290400	Switch(S101)
		A-P
	2-241818-7	Washer, lock int, Tooth
		——— * ———
2	11528-56	Lug, Solder
3	139015	Bracket, Cover
		A-P
	31-129647-82	Nut, Hex
	1-216741-424	Washer Lock Spring
	31-119918-0210	Screw
		——— * ———
4	290240	Nut, Face
5	550303	Handle
		A-P
	31-119918-0210	Screw, Pan Hd
	1-120052-207	Washer lock int Tooth
		——— * ———
6	788413	Cover
7	550164	Guide, Shaft
		A-P
	31-119918-8206	Screw, Pan Hd
	1-118195-307	Washer, Flat
		——— * ———
8	250116	Leadscrew
9	150162	Spring, Drag
10	550137	Nut Assy
	250146	Clamp, Traverse Nut
	150136	Nut, Leadscrew
	20-119922-8216	Screw, Soc Hd
11	550143	Guide Bracket Assy
		A-P
	31-119918-8206	Screw
	1-120052-206	Washer, lock, int, Tooth
		——— * ———
	250142	Bracket, Guide
	139456	Pad, Bearing
12	150161	Spring, Traverse Coupling
		A-P
	20-119922-8212	Screw
	31-129647-82	Nut Hex
	1-118195-307	Washer, Flat
		——— * ———

DRIVE UNIT ASSEMBLY(850160)
MODEL 21-1440-01
FIGURE 7-2 (continued)

ITEM NO	PART NUMBER	DESCRIPTION
13	250159	Clamp, Traverse Drive
14	650145-2	Bearing Bracket Assy, Left
		A-P
	31-119918-0210	Screw
	1-120052-207	Washer, lock int., Tooth
		——— * ———
15	150151	Pulley, Fly Wheel
		A-P
	13-119923-6204	Screw, Set
		——— * ———
16	239008-2	Plate, End
		A-P
	31-119918-8206	Screw, Pan Hd
	1-120052-206	Washer Lock, int Tooth
		——— * ———
17	270276-1	Bracket Capacitor Mtg
18	150163	Bearing, Traverse
		A-P
	31-230773-8206	Screw
	1-118195-307	Washer, Flat Plain
		——— * ———
19	550149	Guide Bearing Plate Assy
		A-P
	31-230773-8206	Screw
	1-118195-307	Washer Flat, Plain
		——— * ———
	150147	Pad, Bearing
	1-112468-19	Pin, Roll
	150148	Plate, Guide Bearing
20	150162	Spring, Drag
21	224913	Shaft, Switch
22	1-118195-307	Washer, Flat, Plain
23	1-227070-3	Retainer, Grip Ring
24	127711-2	Bearing, Sleeve
25	550149	Guide Bearing Plate Assy (same as item 19)
26	150163	Bearing Traverse (same as item 18)
27	290331-5	Belt, "O" Ring
28	290495-11	Pulley
	750166	Motor Assy (includes 29 thru 33)
29	290429-8	Motor (M101)
		A-P
	31-119918-8206	Screw, Pan Hd
	1-120052-206	Washer Lock Int Tooth
		——— * ———

DRIVE UNIT ASSEMBLY(850160)
MODEL 21-1440-01
FIGURE 7-2 (continued)

ITEM NO	PART NUMBER	DESCRIPTION
	No Number	Capacitor, .68uf (supplied with motor)
Not Used		
31	243994-2	Board, Terminal (TB-101)
		A-P
	31-119998-62	Nut Hex
	1-120052-205	Washer lock int Tooth
		——— * ———
32	1-264370-3	Clip, Spring
		A-P
	31-119918-6204	Screw, Pan Hd
	1-120052-205	Washer, lock int Tooth
		——— * ———
33	550139	Motor Bracket Assy
		A-P
	31-119918-0210	Screw Pan Hd
	1-120052-207	Washer, Lock, int Tooth
		——— *———
34	1-118235-4	Switch, Sensitive (S102)
		A-P
	31-119918-6216	Screw, Pan Hd
	31-119998-62	Nut, Hex
	1-120052-205	Washer, Lock, Int Tooth
		——— * ———
35	550141	Switch Bracket Assy
		A-P
	31-119918-0210	Screw Pan Hd
	1-120052-207	Washer Lock Int Tooth
		——— * ———
36	247221	Cord, Power
37	262265-1	Bushing, Strain Relief
38	350165	Plate, Base
39	290496-1	Nut, Acorn
		A-P
	13-119923-4512	Screw, Set
		——— * ———
	650158	Traverse Bar Assy (includes items 40 thru 43)
40	650157	Upright Assy
41	150155	Spring, Turnaround Knob
42	150156	Knob, Turnaround
43	550154	Rod, Traverse
44	239008-1	Plate, End

DRIVE UNIT ASSEMBLY(850160)
MODEL 21-1440-01
FIGURE 7-2 (continued)

ITEM NO	PART NUMBER	DESCRIPTION
		A-P
	31-119918-8206	Screw, Pan Hd
	1-120052-206	Washer lock int Tooth
		——— * ———
45	240731-10	Ring, "E" Retainer
46	290187-3	Bearing, Ball
47	650145-1	Bearing Bracket Assy, Right
		A-P
	31-119918-0210	Screw
	1-120052-207	Washer, lock int Tooth
		——— * ———

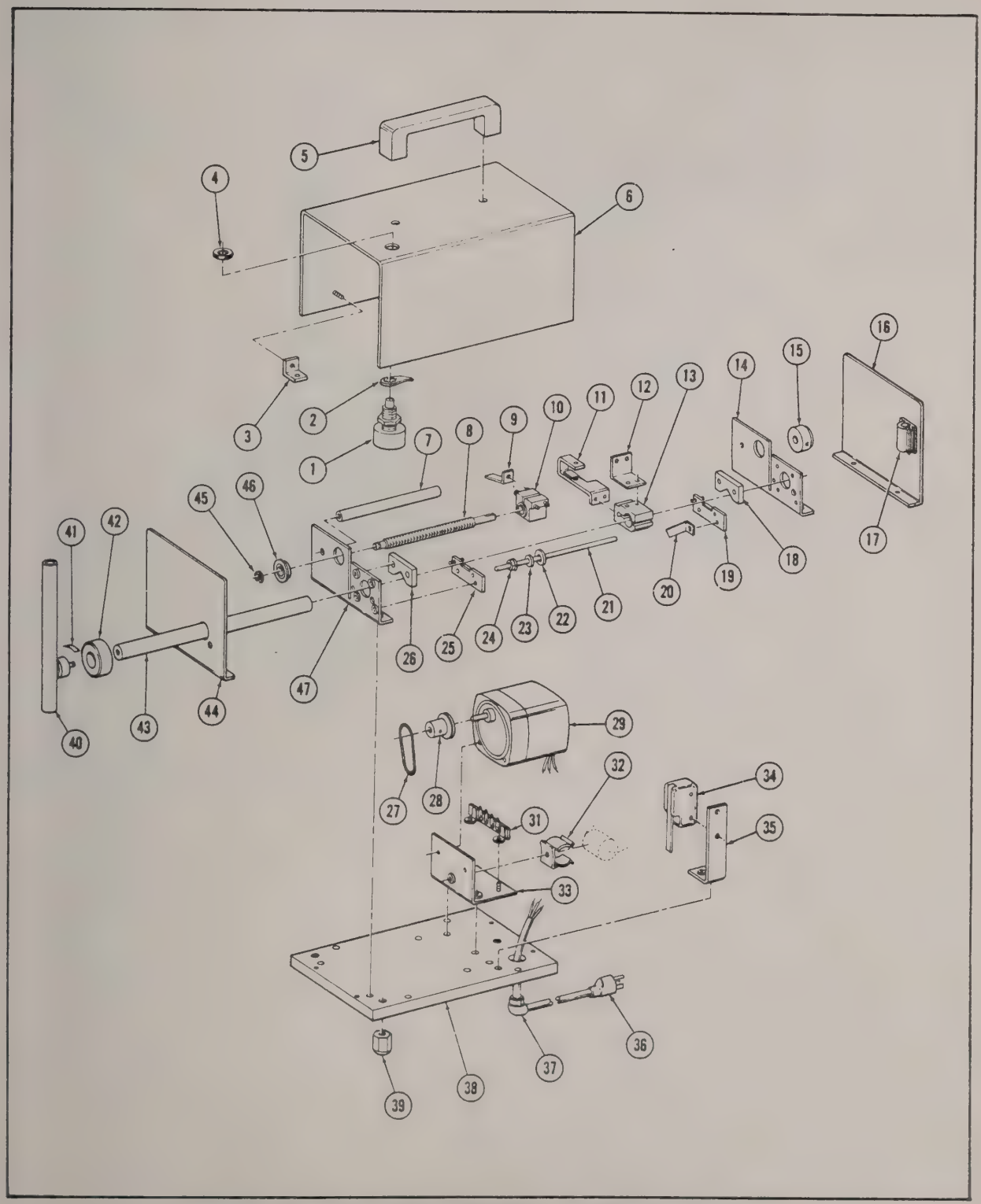


FIGURE 7-2 DRIVE UNIT ASSEMBLY - MODEL 21-1440-01

EXTENSION ARM & CLAMP ASSEMBLY (750254)
FIGURE 7-3

ITEM NO	PART NUMBER	DESCRIPTION
	750254	Extension Arm & Clamp Assembly
	750168	Pickup Clamp Assembly (Includes items 1 thru 6)
1	538905	Clamp Knob Assembly
2	290390-4	Thrust Washer
3	238851	Clamp
4	236250	Spring, Compression
5	650167	Clamp & Stud Assembly
6	136197	Spacer, Clamp Jaw (A-P)
	270178-205	Screw, Drive ——— * ———
7	250211	Retainer Spring, Extension Arm (A-P)
	31-119918-6204	Screw, Pan ——— * ———
	736229	Extension Arm Assembly (Includes items 8 thru 14)
8	636228	Pivot Clamp & Spring Assembly
9	636227	Extension Arm & Pivot Assembly
10	340440	Clamp
11	240459	Pad, Felt
12	10-227070-6	Ring, Retaining
13	138666	Pin, Hinge
14	240460	Spring, Compression

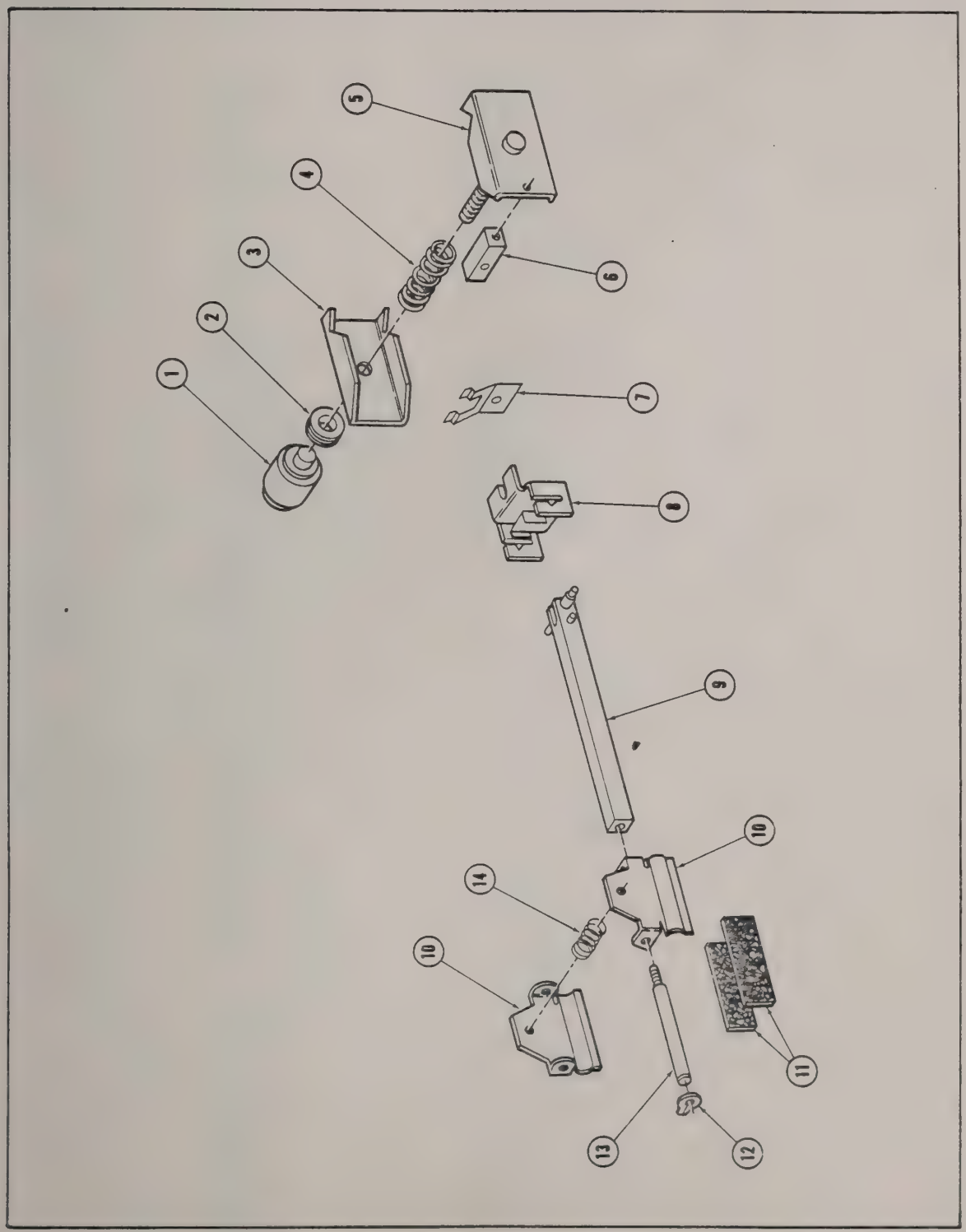


FIGURE 7-3 EXTENSION ARM & CLAMP ASSEMBLY

SURF-INDICATOR ASSEMBLY (839050)
MODEL 21-1350-00
FIGURE 7-4

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
	21-1350-00	Surf-Indicator Assy	
1	738969	Panel, Dress	
2	738965	Meter, Surf-Indicator	M-201
3	680186	Cover, Top Assy	
4	639046	Handle Assy	
5	538980	Knob Assy	
		(Attaching Parts)	
	264143-2	Washer, Spring	
		------ * ------	
	887646	Harness Assy	
6	234670-5	Terminal, Solder	
7	234670-3	Terminal, Solder	
8	247364	Connector, A.C.	P-203
9	265840-1	Terminal Lug, Recpt	
10	240352-502	Capacitor	C-210&C-211
11	266584-2	Contact, Female	
12	290445	Switch, Toggle	S-104
13	537047	Connector, Batt.	
14	290072-18	Connector, PC Female	J-101&J-103
15	269954-203	Resistor, Var.	R-201
16	290397	Switch, Toggle	S-103
17	10-290081-337	Capacitor	
18	241026-15	Terminal Lug	
19	739043	Cutoff Switch Assy	S-101
	10-241145-474	Capacitor .47uf	C-201,C-206
	10-241145-154	Capacitor .15uf	C-203, C-208
	10-241145-473	Capacitor .047uf	C-204, C-209
	10-241145-153	Capacitor .015uf	C-205, C-210
	290097-2	Deck, Switch	
	238908-4	Switch, Index	
20	248226	Socket, Connector	J-102
21	739042	Sensitivity Switch	S-102
	1-281349-10001	Resistor	R-202
	1-281349-33201	Resistor	R-203
	1-281349-10002	Resistor	R-204
	1-281349-33202	Resistor	R-205
	1-281349-10003	Resistor	R-206
	1-117802-3324	Resistor	R-207
	1-117802-1005	Resistor	R-208
	290097-2	Deck, Switch	
	238908-3	Switch, Index	
22	339045-1	Insulator, Paper	
23	637859	Shield, Switch	
24	339045-3	Insulator, Paper	
25	639002	Shield, Switch	
26	129758-1	Fuse Holder	
27	116198-8	Fuse 3AG Slo Blo ½A	F-101
28	739031	Base Sub Assy	
29	266584-1	Connector	J-104

SURF-INDICATOR ASSEMBLY (839050)
MODEL 21-1350-00 (Continued)
FIGURE 7-4

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
		(Attaching Parts)	
30	263806-4	Mounting Hardware	
		----- * -----	
31	339045-2	Insulator, Paper	
32	739038	PC Board Assy, Power (see Figure 7-5)	
	739038-1	PC Board Assy, Power (230V option)	
33	838986	Bracket Shield	
		(Attaching Parts)	
	31-119918-8206	Screw	
	1-216741-424	Washer	
		----- * -----	
34	290378-1	Support, P.C. Board	
35	839037	PC Board Assy, Ampl. (see Figure 7-6)	
36	465913-377	Nameplate	
37	639033-2	Knob Assy - Sensitivity	
38	639033-1	Knob Assy - Cutoff	

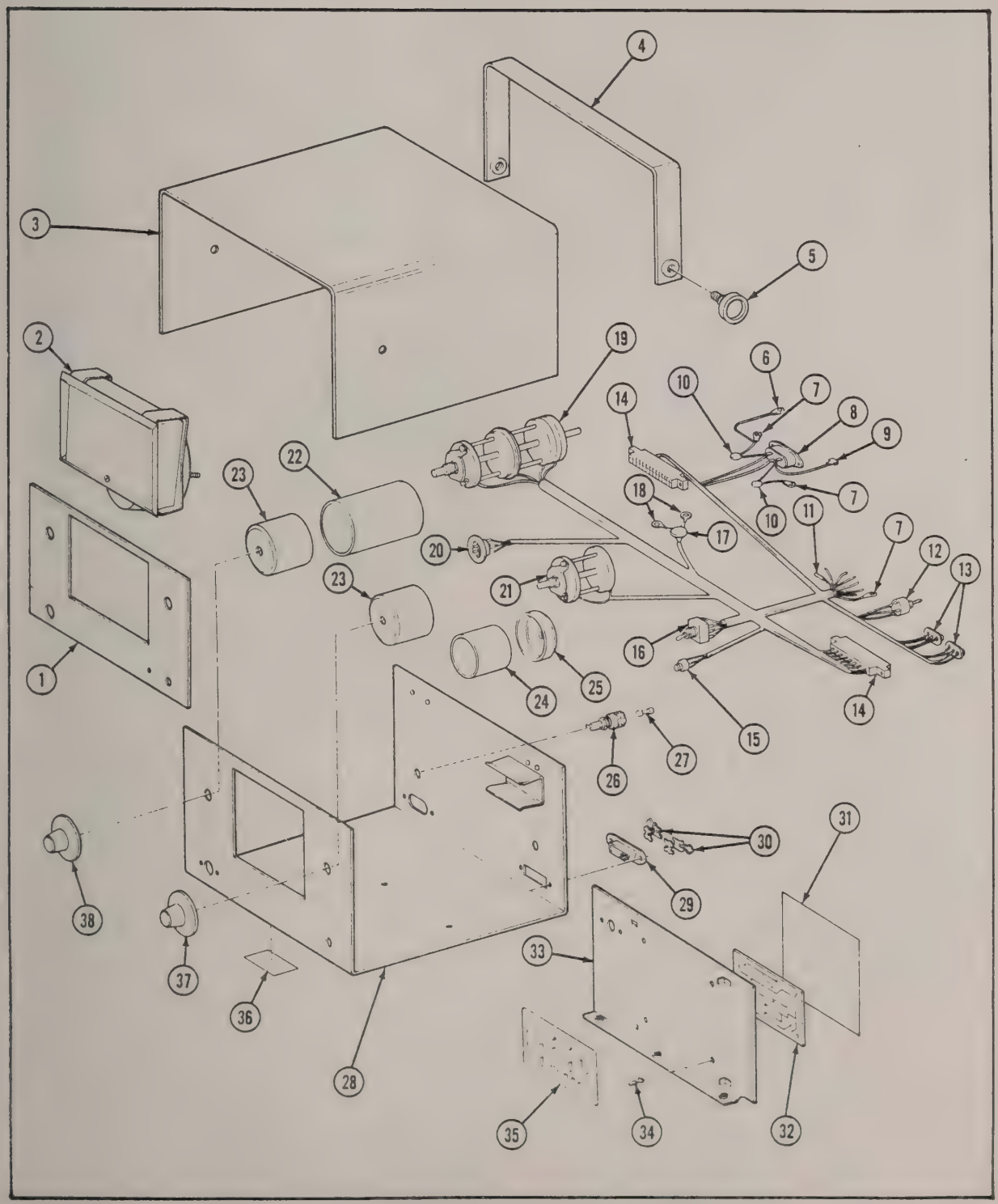


FIGURE 7-4 SURF-INDICATOR ASSEMBLY MODEL 21-1350-00

ELECTRICAL PARTS LIST
SURF-INDICATOR POWER SUPPLY BOARD ASSEMBLY (739038)
FIGURE 7-5

SYMBOL NO	PART NUMBER	DESCRIPTION
C-301	20-263695-105	Capacitor 1uf 20V
C-302	20-263695-105	Capacitor 1uf 20V
C-303	231922-207	Capacitor 200uf 25V
C-304	231922-207	Capacitor 200uf 25V
C-305	10-290373-103	Capacitor .01uf 80V
C-306	10-290373-103	Capacitor .01uf 80V
CR-301	290405 (VS248)	Rectifier Bridge
R-301	5-241111-562	Resistor 5.6K ¼w
R-302	5-241111-562	Resistor 5.6K ¼w
R-303	5-241111-150	Resistor 15 ¼w
R-304	5-241111-150	Resistor 15 ¼w
R-305	5-241111-122	Resistor 1.2K ¼w
R-306	5-241111-681	Resistor 680 ¼w
T-301	238756	Transformer
U-301	282638 (SG350IT)	Integrated Circuit

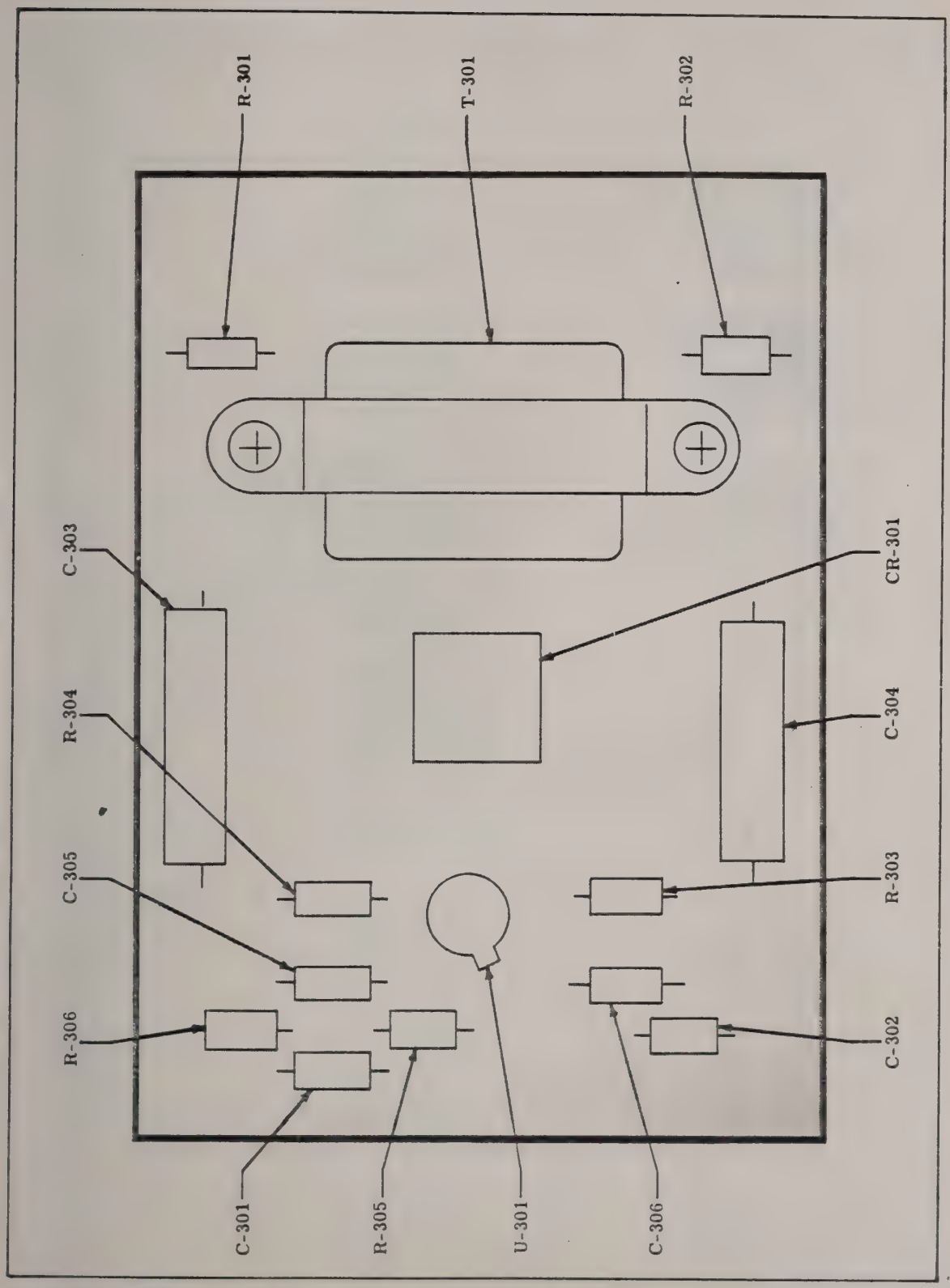


FIGURE 7-5 SURF-INDICATOR POWER SUPPLY BOARD ASSEMBLY

ELECTRICAL PARTS LIST
SURF-INDICATOR AMPLIFIER BOARD ASSEMBLY (839037)
FIGURE 7-6

SYMBOL NO	PART NUMBER	DESCRIPTION
C-101	5-231852-162	Capacitor 1600pF 500V
C-102	5-290040-391	Capacitor 390 pF 100V
C-103	5-290040-680	Capacitor 68pF 500V
C-104	5-290040-330	Capacitor 33pF 500V
C-105	5-290040-680	Capacitor 68pF 500V
C-106	5-290040-470	Capacitor 47pF 500V
C-108	10-290244-107	Capacitor 100uf 10V
C-109	10-290244-107	Capacitor 100uf 10V
C-110	10-290244-107	Capacitor 100uf 10V
C-111	290091-300	Capacitor 30pF 1000V
C-112	10-290244-107	Capacitor 100uf 10V
C-113	10-290244-107	Capacitor 100uf 10V
C-114	10-290081-337	Capacitor 330uf 6V
C-115	10-290081-337	Capacitor 330uf 6V
C-116	10-290244-107	Capacitor 100uf 10V
C-117	290091-300	Capacitor 30pF 1000V
C-118	231707-507	Capacitor 500uf 15V
CR-101	290099 (1N695)	Diode
CR-102	290099 (1N695)	Diode
CR-103	290099 (1N695)	Diode
CR-104	290099 (1N695)	Diode
CR-105	290099 (1N695)	Diode
CR-106	290099 (1N695)	Diode
*Q-101	537386 (2N5457)	Transistor
*Q-102	537386 (2N5457)	Transistor
R-101	5-241111-304	Resistor 300K ¼w
R-102	5-241111-514	Resistor 510K ¼w
R-103	5-241111-105	Resistor 1meg ¼w
R-104	5-241111-205	Resistor 2meg ¼w
R-105	5-241111-395	Resistor 3.9meg ¼w
R-106	5-241111-106	Resistor 10meg ¼w
R-107	5-241111-226	Resistor 22meg ¼w
R-108	5-241111-107	Resistor 100meg ¼w
R-109	5-241111-106	Resistor 10meg ¼w
R-110	5-241111-822	Resistor 8.2K ¼w
R-111	5-241111-473	Resistor 47K ¼w
R-112	5-241111-222	Resistor 2.2K ¼w
R-113	5-241111-106	Resistor 10meg ¼w
R-114	5-241111-822	Resistor 8.2K ¼w
R-115	5-241111-434	Resistor 430K ¼w

ELECTRICAL PARTS LIST
SURF-INDICATOR AMPLIFIER BOARD ASSEMBLY (839037)
FIGURE 7-6 (continued)

SYMBOL NO	PART NUMBER	DESCRIPTION
R-116	5-241111-473	Resistor 47K ¼w
R-117	5-241111-222	Resistor 2.2K ¼w
R-118	5-241111-332	Resistor 3.3K ¼w
R-119	5-241111-222	Resistor 2.2K ¼w
R-120	5-241111-821	Resistor 820 ¼w
R-121	5-241111-434	Resistor 430K ¼w
R-122	1-247334-1821	Resistor 1.82K 1/8w
R-123	5-241111-222	Resistor 2.2K ¼w
R-124	5-241111-821	Resistor 820 ¼w
U-101	290369	Integrated Circuit
U-102	290369	Integrated Circuit

* Matched Pair

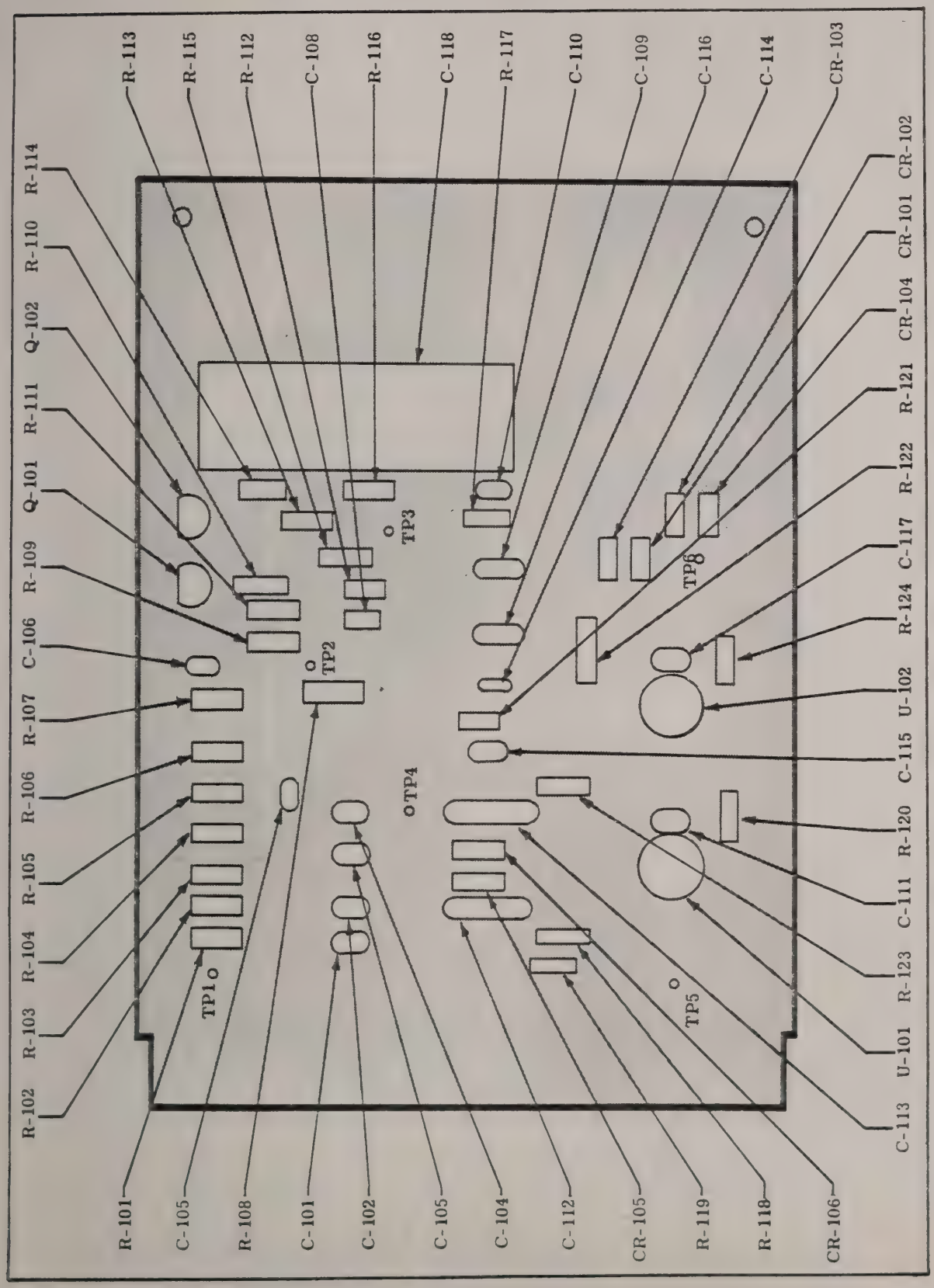
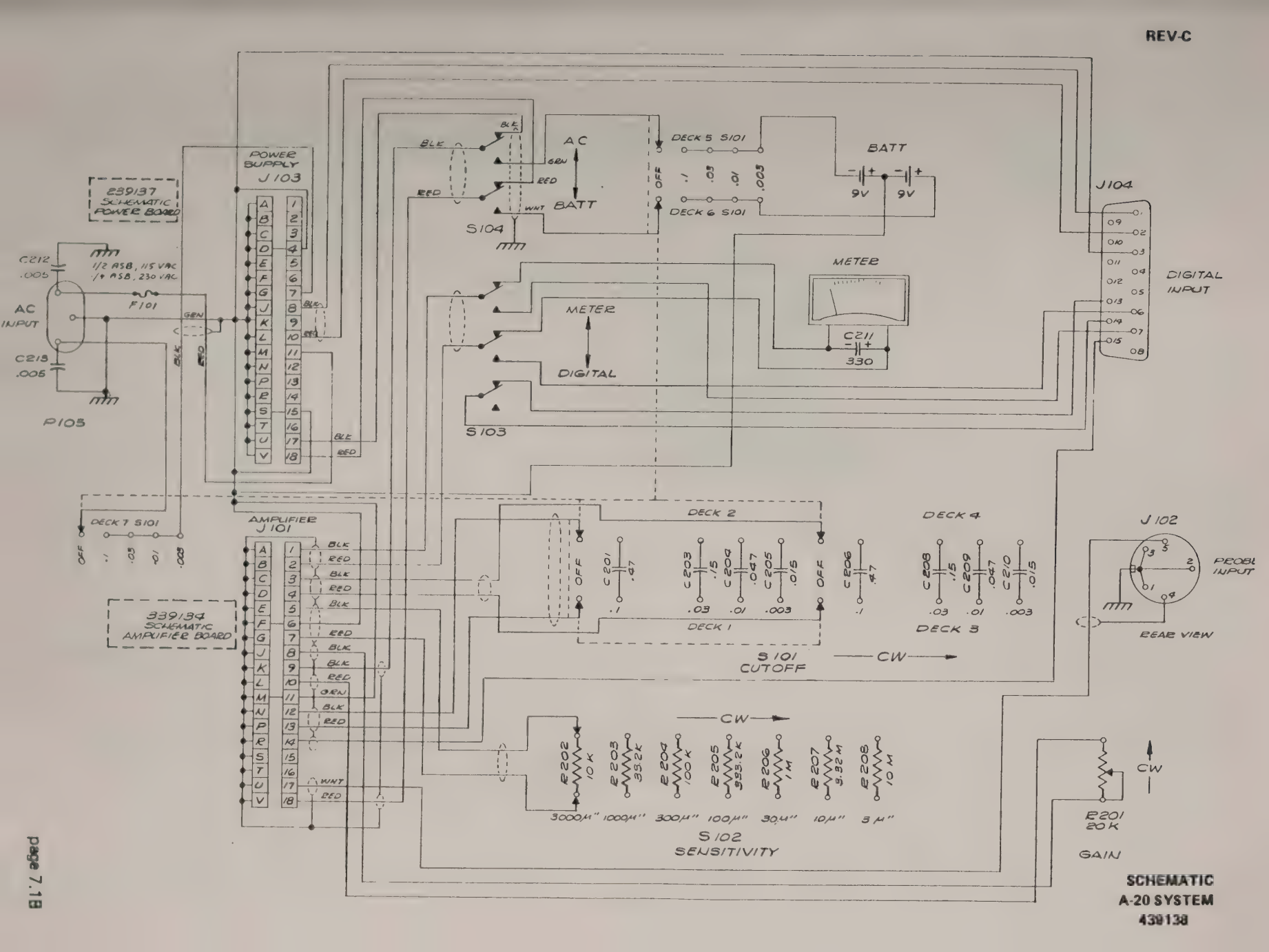
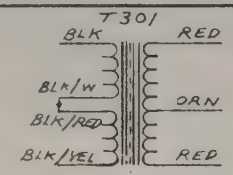


FIGURE 7-6 SURF-INDICATOR AMPLIFIER BOARD ASSEMBLY

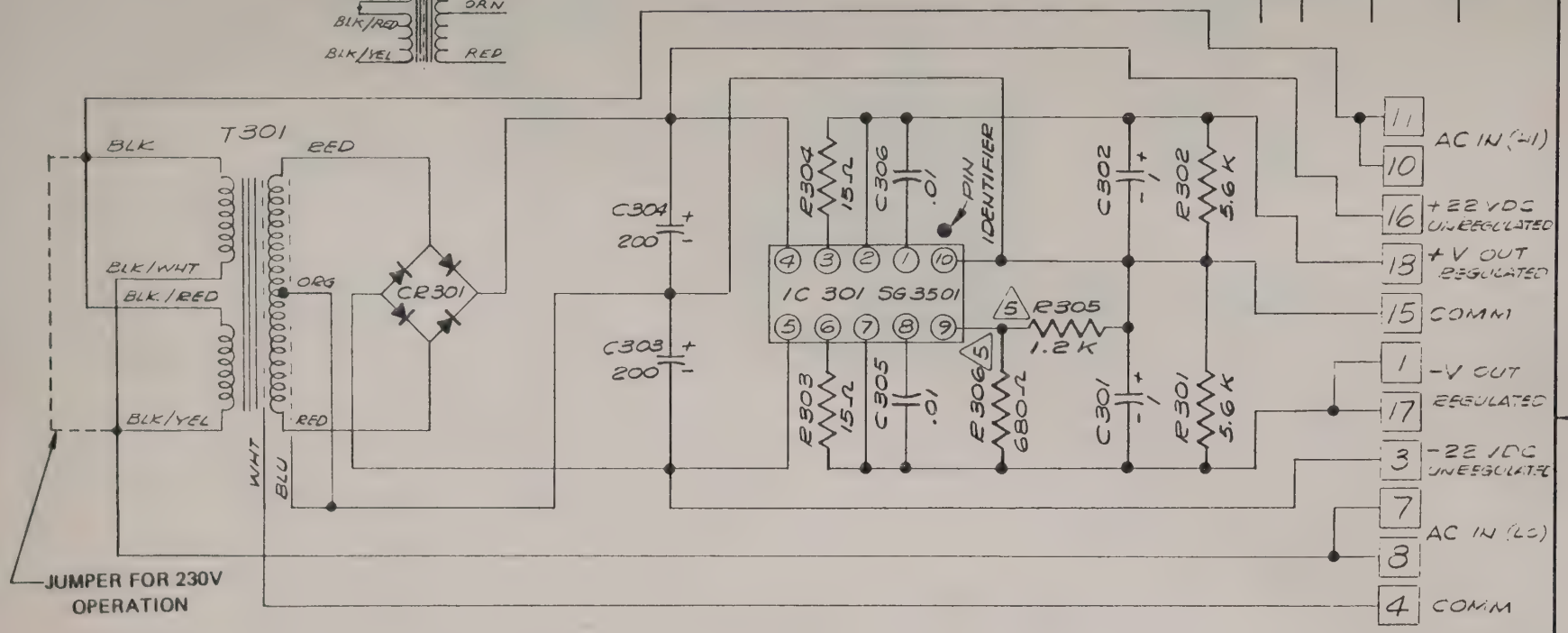

REV-C
POWER SUPPLY J 103
239137 SCHEMATIC POWER BOARD
C212 .005
1/2 ASB, 115 VAC
1/4 ASB, 230 VAC
F101
AC INPUT
C213 .005
P105
S104
AC
BATT
S103
METER
DIGITAL
DECK 5 S101
DECK 6 S101
OFF
.1
.05
.01
.005
BATT
9V
9V
C211
330
J104
DIGITAL INPUT
AMPLIFIER J 101
339134 SCHEMATIC AMPLIFIER BOARD
DECK 7 S101
DECK 2
DECK 4
DECK 1
DECK 3
C201 .47
C203 .15
C204 .047
C205 .015
C206 .47
C208 .15
C209 .047
C210 .015
.03
.01
.003
.1
S101 CUTOFF
CW
J 102
PROBE INPUT
REAR VIEW
R202 10 K
R203 33.2K
R204 100K
R205 332.2K
R206 1 M
R207 3.32 M
R208 10 M
3000μ" 1000μ" 300μ" 100μ" 30μ" 10μ" 3 μ"
S102 SENSITIVITY
R201 20 K
GAIN
SCHEMATIC
A-20 SYSTEM
439138
page 7.18

239137 1



TRANSFORMER HOOKUP
FOR 230 V OPERATION

REVISIONS			
SYM	EO NO	DATE	APPROVED
A	REEL	10-10-72	THOSS
B	2356	11-15-71	THOSS



5. R305 & R306 TO BE CHOSEN FOR REGULATED VOLTAGE OUTPUT FROM ±3 TO ±15 VDC. VALUES SHOWN FOR ± 9 VDC

4. HIGHEST RESISTOR NO. R306

3 HIGHEST CAPACITOR NO. C306

2. ALL RESISTANCE IN OHMS

1. ALL CAPACITORS IN MICRO-FARADS

NOTES: UNLESS OTHERWISE NOTED

ITEM	QTY.	PART NO.	DESCRIPTION
LIST OF MATERIAL			

TOLERANCES: UNLESS OTHERWISE SPECIFIED ALL TOLERANCES ARE PER SPECIFICATIONS 230900	DWN. D Chase	DATE 10-9-72	TITLE: SCHEMATIC, POWER BOARD
MATL.	CHKD.		
PROTECTIVE FINISH	APPR. Berger	10/10/72	
	NEXT ASSY 839050	CODE IDENT.	ISSUE CODE
		SCALE NONE	21-1550-00
			NO. 239137

8-70 DIETERICH POST CLEARPRINT 1000H-10 FORM 201 270

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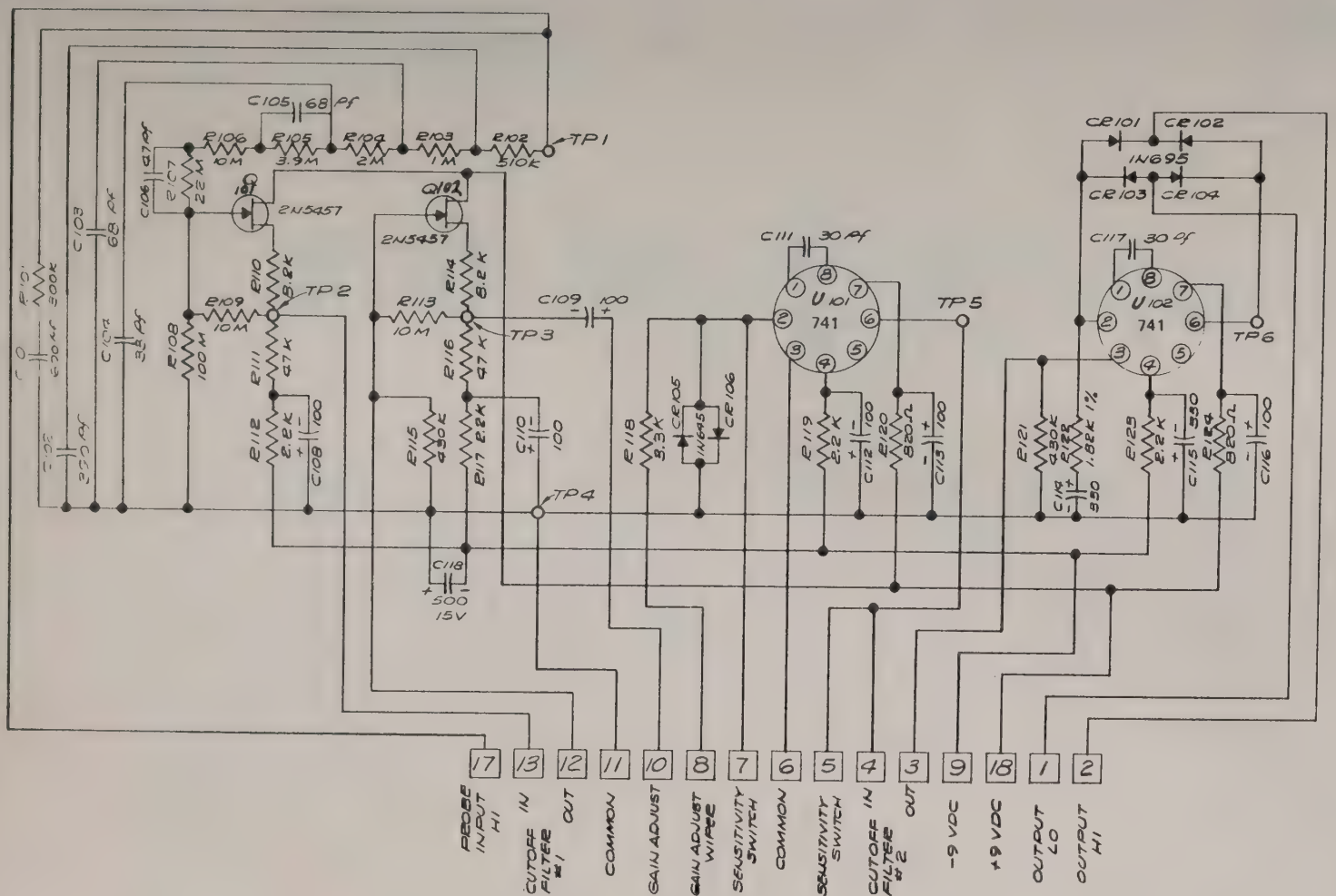
REV-B



4. HIGHEST RESISTOR NO. R 124
3. HIGHEST CAPACITOR NO. C116
2. ALL RESISTANCE IN OHMS
1. ALL CAPACITORS IN MICRO-FARADS

NOTES UNLESS OTHERWISE NOTED

ITEM	QTY	PART NO.	DESCRIPTION
			LIST OF MATERIAL

TOLERANCES: UNLESS OTHERWISE SPECIFIED ALL TOLERANCES ARE PER SPECIFICATIONS 830900	DWN D Hass	DATE 9/13/72	TITLE: SCHEMATIC AMPLIFIER BOARD
MATL.	CHKD.		
PROTECTIVE FINISH	APPD. Burgess	10/10/72	
	NEXT ASSY 839050		CODE IDENT. / ISSUE / NO. 339134
		SCALE NONE	SIZE 21-1350-00

339134

DIGITAL READOUT
MODEL 21-1360-01
FIGURE 7-7

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
	21-1360-01	Digital Readout Assy	
	21-1360-56	Digital Readout Assy (230V)	
1	639033-3	Knob Assy, Switch	
2	787296	Panel Assy	
3	650186-1	Cover, Top	
4	639046	Handle Assy	
5	264143-2	Washer, Spring Crescent	
6	538980	Knob Assy	
	886962	Board Assy DPM (Data Tech)	
7	2-280755-130	Connector	J-101
8	2-280755-120	Connector	J-102
	886961	Board Assy, DPM (Weston)	
	2-280755-130	Connector	J-101
9	887337	Board Assy (see Figure 7-8) (A-P)	
	31-119918-6204	Screw, Pan, Phil	
	1-120052-205	Washer, Int. Tooth	
		——— * ———	
	687293	Harness Assy	
10	290022-202	Resistor, Variable 2K .5w	R-202
11	290397	Switch, Toggle	S-203
12	9-281501-10	Connector, Female	J-104
13	281502	Contact	
	687294	Harness Assy	
14	9-281501-5	Connector, Female	J-103
15	287488	Switch & Pot Assy	S-201 & R-201
16	290412	Switch, Toggle SPDT	S-202
17	266583-6	Lug, Solder	
18	290402	Feet, Adhesive	
19	887299	Case Assy	
20	287515-1	Label	
21	283859-1	Digital Panel Meter (Data Tech)	
	283859-2	Digital Panel Meter (Weston)	
22	287515-2	Label	

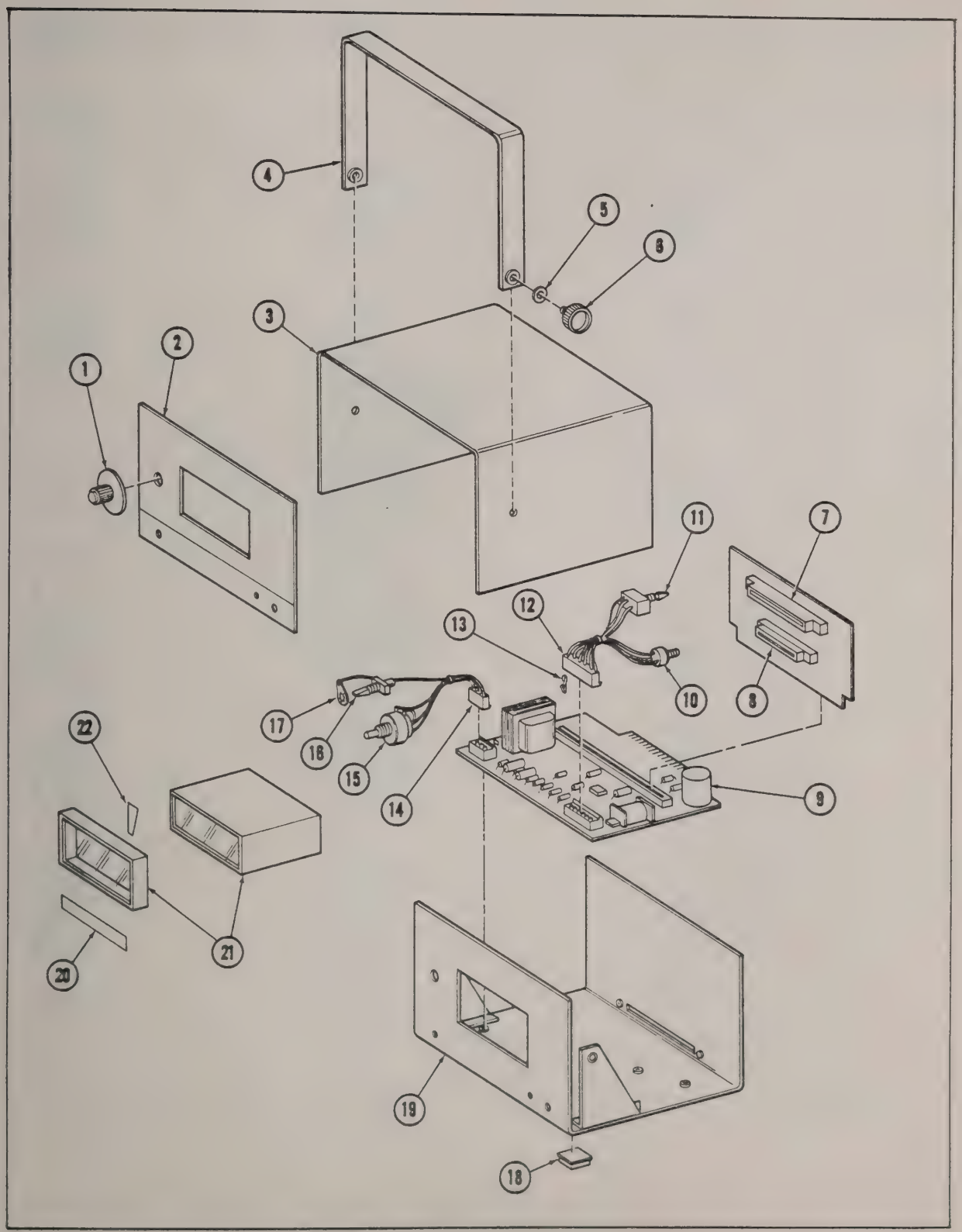
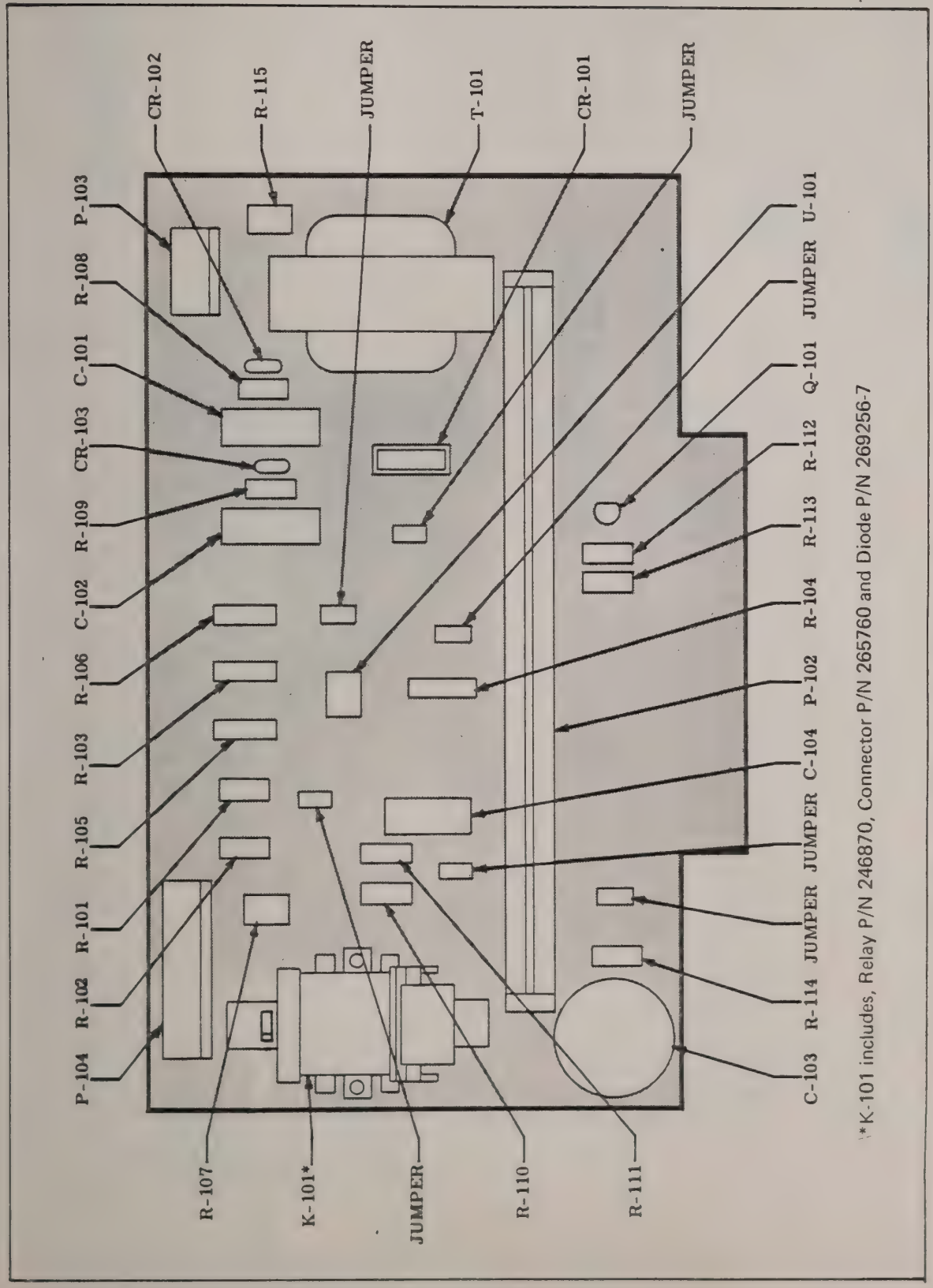


FIGURE 7-7 DIGITAL READOUT - MODEL 21-1360-01

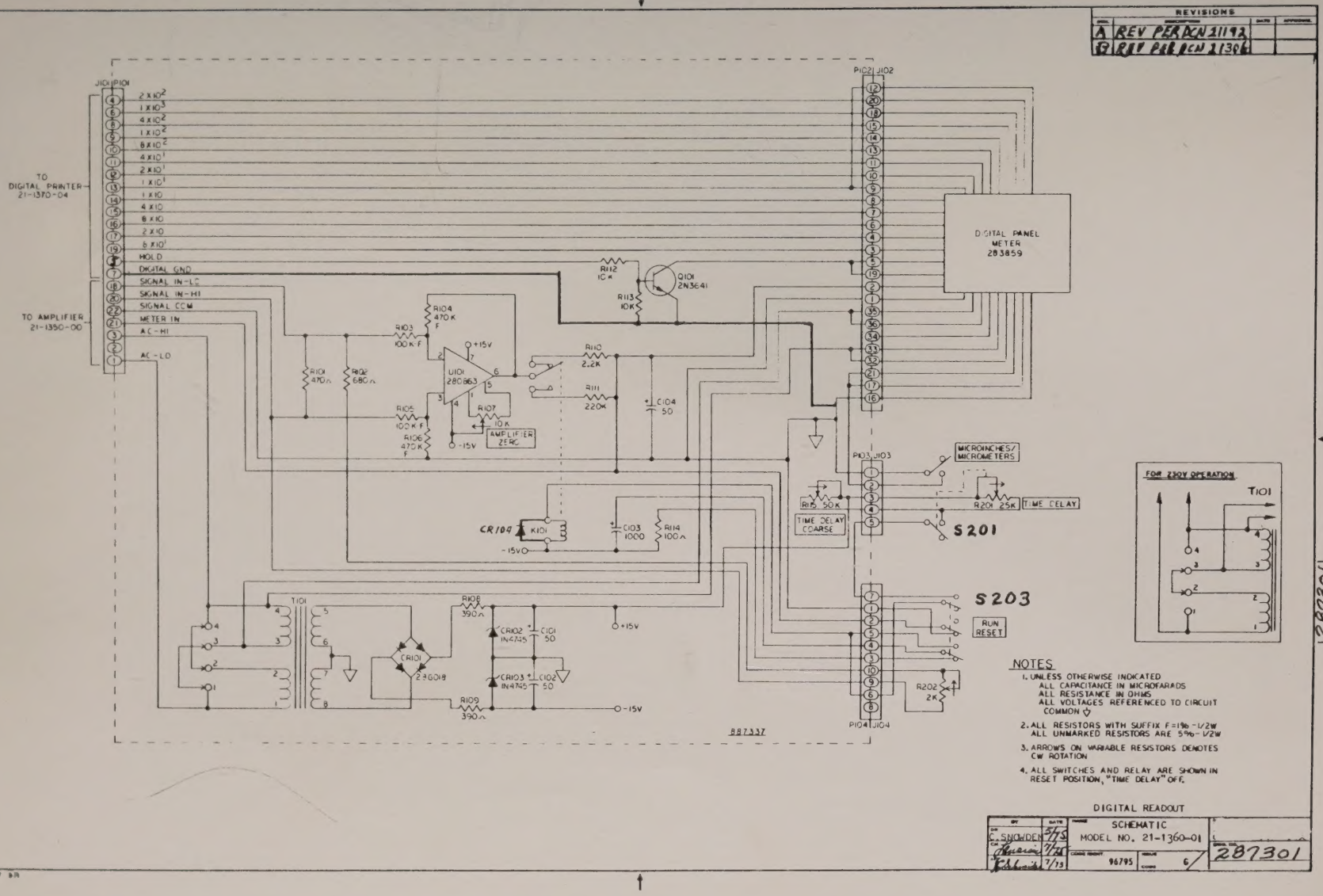
ELECTRICAL PARTS LIST
DIGITAL READOUT BOARD ASSEMBLY (887337)
FIGURE 7-8

SYMBOL NO	PART NUMBER	DESCRIPTION
C-101	231922-506	Capacitor
C-102	231922-506	Capacitor
C-103	286010-108	Capacitor
C-104	231707-506	Capacitor
CR-101	286018-1	Diode Assy
CR-102	230061-3	Diode
CR-103	230061-3	Diode
CR-104	269256-7	Diode
K-101	687292 (Made up of Relay 246870 and Contacts 265760-1)	Relay Assy
P-102	283768-36	Connector
P-103	281711-5	Connector
P-104	281711-10	Connector
Q-101	263500	Semiconductor
R-101	5-115557-101	Resistor 100 ½w
R-102	5-115557-681	Resistor 680 ½w
R-103	1-117802-1003	Resistor 100K ½w
R-104	1-117802-4703	Resistor 470K ½w
R-105	1-117802-1003	Resistor 100K ½w
R-106	1-117802-4703	Resistor 470K ½w
R-107	269085-103	Resistor, Variable
R-108	5-115557-391	Resistor 390 ½w
R-109	5-115557-391	Resistor 390 ½w
R-110	5-115557-222	Resistor 2.2K ½w
R-111	5-115557-224	Resistor 220K ½w
R-112	5-115557-103	Resistor 10K ½w
R-113	5-115557-103	Resistor 10K ½w
R-114	5-115557-101	Resistor 100 ½w
R-115	269085-503	Resistor, Variable
T-101	285596	Transformer
U-101	280863-3	Semiconductor, IC



*K-101 includes, Relay P/N 246870, Connector P/N 265760 and Diode P/N 269256-7

FIGURE 7-8 DIGITAL READOUT BOARD ASSEMBLY



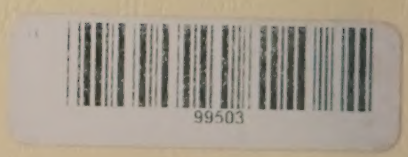
NOTES

1. UNLESS OTHERWISE INDICATED
   ALL CAPACITANCE IN MICROFARADS
   ALL RESISTANCE IN OHMS
   ALL VOLTAGES REFERENCED TO CIRCUIT COMMON
2. ALL RESISTORS WITH SUFFIX F=1%-1/2W
   ALL UNMARKED RESISTORS ARE 5%-1/2W
3. ARROWS ON VARIABLE RESISTORS DENOTES CW ROTATION
4. ALL SWITCHES AND RELAY ARE SHOWN IN RESET POSITION, "TIME DELAY" OFF.

DIGITAL READOUT

BY	DATE	SCHEMATIC	
C. SNOWDEN	3/15	MODEL NO. 21-1360-01	
	7/25		
	7/13	96795	287301

287301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